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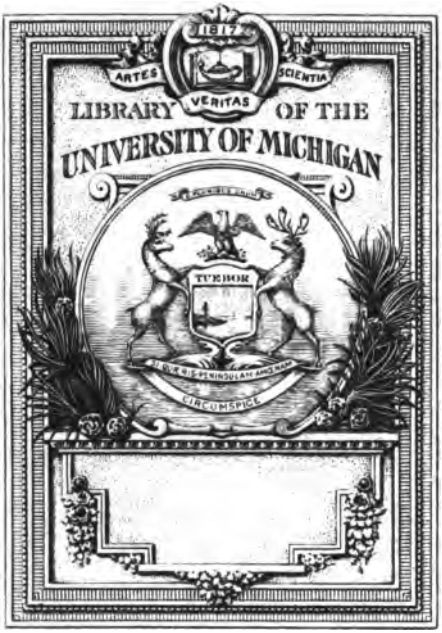
THE MARBLE BORDER

OF

WESTERN NEW ENGLAND

MIDDLEBURY HISTORICAL SOCIETY,
MIDDLEBURY, VT.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THE

MARBLE BORDER

OF

WESTERN NEW ENGLAND.

ITS GEOLOGY AND MARBLE DEVELOPMENT IN THE PRESENT CENTURY.

PAPERS AND PROCEEDINGS OF THE

MIDDLEBURY HISTORICAL SOCIETY.

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CONTENTS.

Page.

MIDDLEBURY HISTORICAL SOCIETY.

INTRODUCTORY, - - . - - - - **1**
PHILIP BATTELL, ESQ.

MAP OF MARBLE BORDER.
PROF. EZRA BRAINERD.

GEOLOGY OF THE MARBLE BELT, - - - - **9**
PROF. EZRA BRAINERD.

MARBLE FIELDS AND MARBLE INDUSTRY, - **23**
PROF. HENRY M. SEELY.

APPENDIX, - - - - - - - - - **53**

Development of Machinery, - - - - **55**

Correspondence—Letters from:

Rich'd Colles, Esq., Kilkenny, Ireland, - - **57**

Rev. J. Graves, Kilkenny, Ireland, - - **58**

James Clapp, M. A., London, England, - - **59**

Ralph Buckingham, Esq., Marbledale, Conn., - **60**

Chas. J. Taylor, Esq., Great Barrington, Mass., - **61**

John Struthers, Esq., Philadelphia, Pa., - - **64**

Early Marble Work at Middlebury, - - - **65**

Local Question of Invention, - - - - **66**

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MIDDLEBURY HISTORICAL SOCIETY.

THE MIDDLEBURY HISTORICAL SOCIETY was organized November 27, 1843, its members having in view, as a specialty, the cultivation of New England and American history, and the promotion of an interest in that department of intelligence in the community. There were at first but nine gentlemen associated, which number was very soon increased, by election, to twelve, all residents of Middlebury, the plan of action being simply that of a literary club. Its officers were a president and secretary, the latter also treasurer and curator of collections. The officers first chosen were Hon. Samuel Swift, president, and Philip Battell, Esq., secretary, who were continued in office until 1846, when Rev. Benjamin Labaree, D. D., was chosen president, and George S. Swift, Esq., secretary. A standing committee of two members besides the secretary was constituted for all general purposes not otherwise provided for. New members were elected from time to time from the town and vicinity, honorary members in Addison County, and corresponding members out of it. Meetings were held monthly, or quarterly, as seemed expedient, at which historical papers were read and discussions held, the former with some collections of manuscripts and curiosities being preserved. In February, 1847, a project was adopted to procure the preparation of town histories of all the towns of Addison County, with a view to their publication as soon as prepared. A special committee was constituted for this object, by whom historians were selected in each town, and commissioned by a circular from the society minutely defining the comprehensive work to be done. The appointments were accepted or others made. and an interest in the design was extended in

the towns. Eight or ten of such histories were prepared and reported. Of these, four in a complete form and of high merit were published, chiefly by the towns interested and by local subscription. The first was that of Middlebury, with a preliminary historical account of Addison County, introductory to the series, by Hon. Samuel Swift, in 1859. The History of Salisbury, by John M. Weeks, Esq., followed in 1860; that of Shoreham, by Rev. Josiah F. Goodhue, in 1861; that of Cornwall, by Rev. Lyman Matthews, in 1862. Histories of Orwell and Bristol were also prepared, by Hon. Roswell Bottum and Hon. Harvey Munsill, of which the former was published in 1880. The society has sustained since 1843 an annual celebration of the landing of the Pilgrims, regarding the Plymouth colony as the starting point of New England history and its character as typical of American civilization. The plan of organization of the Society is still maintained. In 1843 it was the nineteenth of the historical associations in the United States, as recognized by the Department of Education in 1876, when the number had increased to eighty, many of them representing with distinction their relations to the country and urging an active emulation upon others in the interests they serve. The present officers of the Society are:

HON. JOHN W. STEWART, ... *President,*
PHILIP BATTELL, Esq., ... *Secretary,*
PROF. EZRA BRAINERD,
RUFUS WAINWRIGHT, Esq., } *Standing Committee.*

*** The insignia of the Society associate it with Middlebury, in a view of its landmark hill, Chipman Hill, from the south, painted by C. Rogers in 1845, with an indication of Vermont—the star that never sets—from the crest of the complete device, brought within the compass of the seal. The latter was engraved by Weed, Parsons & Co., of Albany, N. Y.; the map of the border—drawn by Prof. Brainerd—by Charles Van Benthuysen & Sons of the same city.

INTRODUCTORY.

THE attention of the Middlebury Historical Society was called to the history of the marble industries of New England by a question which had arisen in the town as to the inventions in the mechanical arts which might be claimed for its citizens, and be honorably inscribed upon a tablet to be placed as a memorial in the new Town Hall. The relation of Middlebury to the subject had been conspicuous among its local industries in all the more active period of manufactures here, sustained for more than a third part of the present century, and a claim had arisen, in circumstances to invite a degree of popular interest, that its success was to be traced to the indigenous invention of its principal processes here, adopted by the founder of the business at Middlebury, and afterwards diffused and made effective in universal use. The character of a claim of so high pretension could not be indifferent to any persons interested in the honor of the town, nor the proposal to give it a public sanction of the kind, depending on historical evidence, be indifferent to any whose attention was habitually attracted to historical questions. The subject was therefore referred to a member familiar with topics of industrial interest, Professor H. M. Seely, formerly secretary of the State Board of Agriculture, for examination. At the next succeeding meeting of the Society, January 26th, 1884, an article was read by Professor Seely, presenting an elaborate review of the subject so far as historical authorities were immediately accessible, and so far disposing of the question before the people that the article was committed to the standing committee of the Society for publication, in such form as they should prefer. The publication was made in the

Middlebury *Register*; an answer subsequently appeared, to which a brief rejoinder, first read to the Society, was also published.

In the meantime the society had been struck with the character and extent of the investigation which had thus incidentally been opened to it. Whatever the mechanical facts might have been it was evident that their obscurity had been but little disturbed; that while art in marble had struggled along with some beneficent gleams of usefulness from one generation or people to another, from one era into another, with gleams of admiration public and private upon it, art in history which rehabilitates the elements of social progress in man, if possible with spirit refined, was indifferent to it. The more comprehensive and special the modern book consulted the deeper the shade that obscured its inadequacy. The more intelligent the general student whom a correspondent might consult, the more startling his confession that the subject was quite new to him, and except in the case of one most incisive and accurate of investigators in New England, with the aid accessible to them it seemed likely to remain so. His research had elasticity enough to look for the stream if its fountain head were hidden, and trace it to its origin.

From this point, discovered by Professor Dexter of Yale College, the secret of the course of American marble history was in the rocks, and the revelation of it followed up the marble belt by the successive openings through the line. To these the clews in some few instances were already in hand, for happily the relationships of society within the western border once so familiar were not entirely obsolete, and the fellowship of scientific studies, recognized by that of commercial interest in the subject, facilities of inquiry were revived over mysteries of nature wrought long periods ago. The town histories disclosed something, amicably in some instances as to parties in the trade, the scientific surveys of the states more liberally to those in their secret, who had not forgotten the fact. But the living sympathy of men face to face is the truest interpreter between them, and by this impressions slowly or partially received were verified or extended.

Professors Brainerd and Seely had been particularly interested in carrying out the investigation, the former representing the department of applied science in Middlebury College, the latter that of Chemistry and Mineralogy. The entire route of the principal localities, at present or formerly operated, was visited by them south of Middlebury during their April vacation, and their return signalized at the regular meeting of that month by a display of specimens obtained in the excursion, and from localities north, all distinctly characteristic, illustrated by their colloquial explanations and a sketch of the border map prepared by Mr. Brainerd. The completed papers of these gentlemen were read at the regular meeting June 29th, when it was voted that the society shall enter upon the design of the publication of its collections with the timely and interesting articles now read; that they be referred to the Standing Committee for publication, together with the correspondence elicited by the investigation and other related matter. The official statement, prepared by Professor Seely, of the reference of the local question of invention, with the decision of the Referees chosen is also given in the appendix.

The geographical traits of the New England border have been controlling in its history. As the country inclines upon the Sound it has its character with that of the tide-water system, along which the first settlements extended. But soon another jurisdiction was met at the west and in receding from the coast a profile of boundary corresponding to it. The character of the surface at the east favored the invi tation of a river country between these lines, and the movement of population obeyed it. The historian sees it in masses from Stratford and Milford, townsmen acting municipally upon it, churches and families separating cordially in the common impnlse for new parishes and homes in the Woodbury territory and New Milford beyond. The border is more distinctly defined at the South Massachusetts line in Berkshire county, which extends northerly across the State, and has never been without a history or witnesses in the better spheres of life to make it known. It rests upon the kindred commonwealth of

Connecticut along the Housatonic, which in Litchfield county descending three hundred feet or more, enters the river line between Fairfield and New Haven counties in seeking the coast. But the family names in the gardens of new settlement between the outer Taconic line of Berkshire and the wider gneissoid uplift that continues the Green Mountains from the north, mingling with or passing groups already planted from the east, were the household words of towns and hamlets first settled below and have lost nothing of harmony or fullness in the new scenes they animate, all for industry, not all for peace.

A souvenir of this period is found in a printed sermon, eloquent and patriotic, it is said, of the Rev. Nathaniel Taylor, the distinguished minister of New Milford, delivered by him, as chaplain of Col. Whiting's regiment at Crown Point, at the close of the prosperous campaign of 1759, illustrating the fact that the later French war was to all New England but a reconnoisance in force in respect to the occupation of the country. The sympathy of energetic men was enlisted by it, and leadership was stimulated as difficulties arose. The single New Hampshire charter, alighting upon Bennington in 1749, that waited so long for summer, was at the peace followed by others that flew in covies from Portsmouth and gathered nowhere so plenteously for flight in numbers as along the fresh fields of the border, where the air rustled with them. Chittenden, the popular civil leader for Vermont, born at Guilford on the Sound, was trained in citizenship till middle life at Salisbury, in Connecticut, and made his new home in the Grants in the county which took his name, on the Winooski. The Warners emigrated from Woodbury in 1766, the Allens joined them from Salisbury and, including Baker, the military leaders were at school with the people at Bennington. The Chipman family found their home at Tinmouth, in Rutland county, while their son, who earliest was first in his profession in the State, having resigned a Lieutenancy in the army entered upon from college, looking towards the Grants was studying his profession at Salisbury. Following the laity, Rev. Job Swift, first at Richmond, Berkshire county, then at

Amenia, N. Y., as pastor, himself from Kent, his wife a Sedgwick of the Cornwall family, when in full maturity became established at Bennington, ennobling his ministry by its usefulness, his more extended service in the State by his disinterestedness. The name of Hall at Bennington, coming up from Guilford by Roxbury, venerable now in its third generation, has attested the order of coming of those who constituted the State.

In September, 1798, Rev. Timothy Dwight, in his fourth year as President of Yale College, made his first vacation journey of observation into Western Vermont, his Journey to Vergennes. He passed the first day twenty-three miles to Waterbury, the next day through its west parish, now Watertown, to Litchfield. In the next town to Litchfield, Goshen, its elevation and the view it commands suggest the contrasts of formation he overlooks and the extent of country north and south they enclose. He makes a note of limestone not pure, as he descends the high lands toward the channel of the Housatonic. At South Canaan he is told by Mr. Farrand, the minister, of an Italian for some time a resident there, who had found at the foot of a ragged hill at the skirt of the plain west of the street "marble as fine and beautiful as the handsome specimens of his own country." At Stockbridge nothing is reported to him of the marble he recognizes at a later visit. His enthusiasm as to the scenery by the way west of the Housatonic between Canaan falls and Lanesboro, freely expressed perhaps was never dulled, but in this horseback tour, with a younger associate to dismount, he seems not to have tested with a hammer the rocks they observed. At Middlebury he speaks of the falls in Otter Creek, just below the bridge as descending twenty one feet, "formed by a ledge of marble." "Several mills," he says, "had been erected here in 1798, several stores had been built, a considerable number of mechanics and several gentlemen in the liberal professions had chosen the place as their residence. An Academy was nearly completed, intended as the germ of a College."

An earlier but more assured testimony of the rocks is found in the life of the statesman and jurist, Nathaniel Chipman, a pupil in col-

lege of President Dwight and a cotemporary in service in the revolution. Perhaps from a higher field of observation than as an observer merely, he writes to General Philip Schuyler of New York, alluding to a conversation had between them the winter before at Philadelphia, and suggesting the resources of Vermont which might contribute to sustain a canal proposed to be built between the Hudson river and Lake Champlain. "There are also," he says, "in this part of the country numerous quarries of marble"—the letter is dated at Rutland, January 25, 1792—"some of them of superior quality. Machines may easily be erected for sawing it into slabs by water, and in that state it might become an important article of commerce."

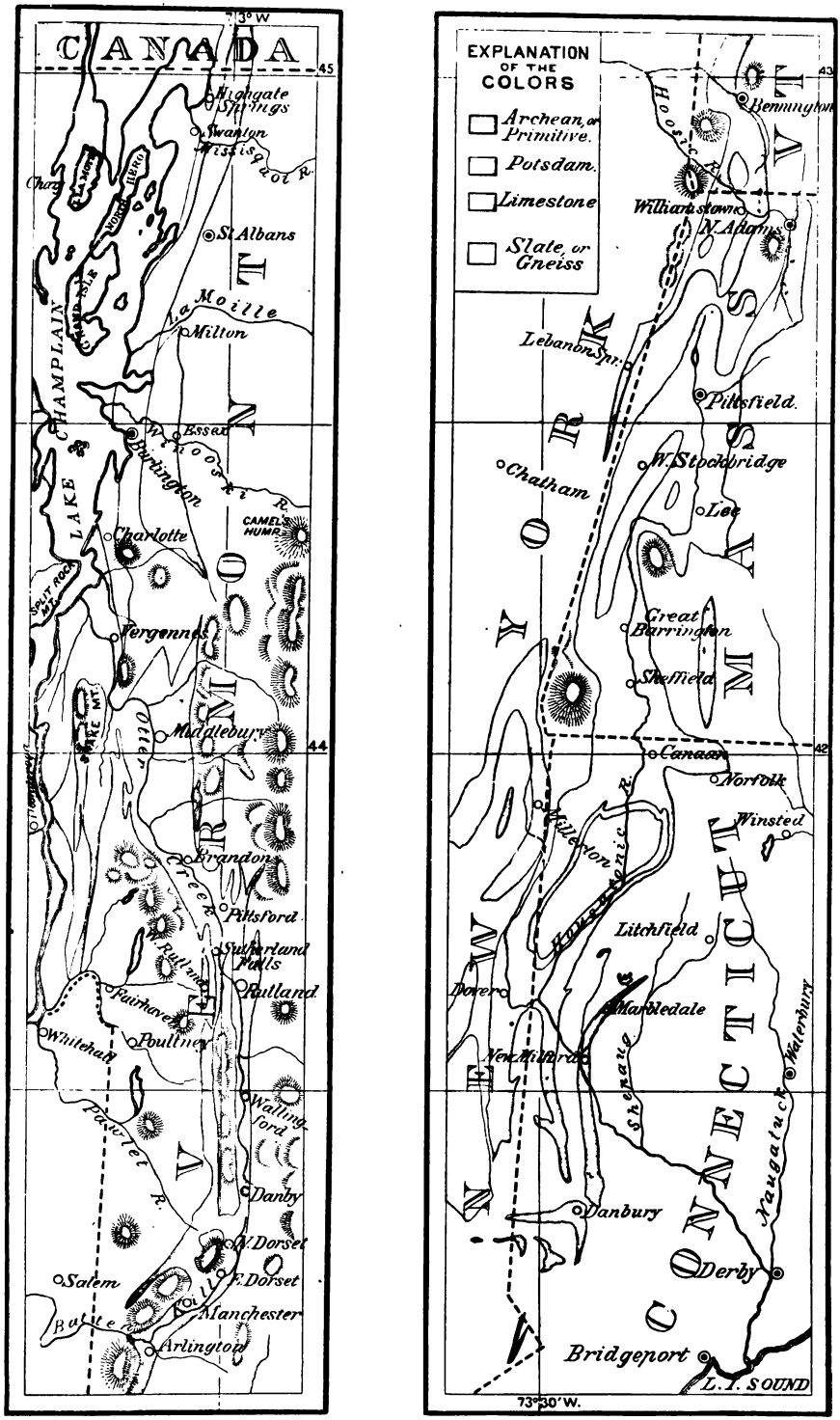
The Otter river from Middlebury having worn the marble barrier away, that once set it back upon its longest and broadest level south, forces a winding channel of descent as by terraces of similar material, six miles, to the Weybridge intervale, afterward in a broader stream, the finest interior river of the State, to the wide triple fall of forty feet at Vergennes, where it reaches the Champlain level. Dr. Dwight was attended here by another former pupil, Col. Seth Storrs, the earliest resident lawyer at Middlebury, and found Judge Enoch Woodbridge, first mayor of the city in 1792, from his circle of friends at Stockbridge, Mass. He notices the city charter of the place, its commercial chances, but chiefly the views shown him from the cupola of the court house, the mountain ranges at either hand so rarely grand to him; the lake system having closed off the Taconic line begun so far to the south, and opened upon the then nameless mountain wilderness of Northern New York, the land border to the north skirting the "glass," as he elsewhere calls the lake at Burlington, and widening as the Green Mountains recede.

P. BATTELL,
E. BRAINERD,
R. WAINWRIGHT,
Standing Committee.

MIDDLEBURY, VT., June 1, 1885.

THE MARBLE BORDER.

ITS GEOLOGY AND DEVELOPMENT.



MARBLE REGION OF WESTERN NEW ENGLAND.

THE GEOLOGICAL FEATURES

OF THE

MARBLE BELT.

BY PROF. EZRA BRAINERD.

THE marbles of Western New England in variety of color, in fineness of texture and in durability surpass those of any other region of the United States. They are found chiefly along the western borders of the States of Connecticut, Massachusetts and Vermont, between the Green Mountain elevation which extends from the Canada line nearly to Long Island Sound, and the intermittent Taconic mountains which extend south of Lake Champlain and in places admit the marble veins within the border of New York. The rivers which drain this valley are the Housatonic flowing south to the Sound, the Hoosic and the Battenkill from near its centre to the Hudson, and the Otter Creek flowing north to Lake Champlain, the first and last mentioned wholly within it. The object of this paper is to present briefly the geological views which have obtained in respect to the marble district and to indicate those more recently established.

The pioneer explorer in American geology was Professor Amos Eaton. He was a leader also in other departments of science; his popular "Manual of Botany," Dr. Asa Gray says, "was for a long time the only general work available for students in this country." In 1817 Prof. Eaton delivered his first course of public lectures to the students of Williams College, from which he had himself graduated in 1799. His success was so great that he determined to continue giving courses of lectures on the natural sciences. This he did in many

places—among others to the Medical school at Castleton, Vt., to the students of Middlebury College in 1824–25, and to the members of the New York Legislature at Albany. Here he—and science—had the good fortune to find a munificent patron in Gen. Stephen Van Rensselaer, who sustained him for nineteen years in his geological labors, enabled him to travel more than 17,000 miles in explorations through New York and neighboring States, published his maps and reports, and finally established the Rensselaer Institute at Troy, with Mr. Eaton as its senior professor.

Prof. Eaton's views in regard to the rocks of Western New England were for many years the accepted views. In 1820 the science of geology was in its infancy even in the old world. It was encumbered by fancies, and the preconceived theories of Werner—in this respect a characteristic German. The fact, that each formation had its peculiar group of fossils, that marked the formation the world over, and distinguished it from every other formation, was not understood. The only method Prof. Eaton knew of at the outset for determining the relative age of strata was to trace them separately through a vast extent of country and to compare their general characters.

According to Mr. Eaton's books, there are five series of rocks in the earth's crust: I. The Primitive; II. The Transition; III. The Lower Secondary; IV. The Upper Secondary; V. The Tertiary. Each series is subdivided into three formations: The Carboniferous, the Quartzose and the Calcareous. The five-fold recurrence of these three formations aids the memory, conduces to system and regularity; though it hardly conforms to the complex facts of nature. Only the two oldest series of rocks were found in our territory,—the Primitive and the Transition. These were distinguished readily by the fact that the former was destitute of any organic remains; the latter contained shells of molluscs and remains of animals allied to the corals. Prof. Eaton calls all the rocks of Western New England, Primitive, excepting the extreme western border of Vermont and Massachusetts. The line of separation passes through Middlebury, Rutland and Williamstown, and from the southwest corner of Massachusetts trends toward

the west across the Hudson just below Poughkeepsie, and on through Orange County to New Jersey. It will be seen, then, that all the marble of Western New England falls into the Primitive series and is, in fact, the upper formation of that series.

Prof. Eaton supposes that these earlier formations once covered the whole earth like the concentric layers of an onion; but that under them along six different north and south lines combustibles were placed at Creation. At the close of the Transition Age, these combustibles were ignited and produced a great explosion, which uplifted the mountain chains of the world. There have been, subsequently, several explosions; but it is supposed that now the combustible materials are too nearly exhausted to produce anything more than ordinary earthquakes.

There was much to admire in the character of Professor Eaton. His pupils, among whom we find Emmons and Hall, were warmly attached to him, and inspired with his own ardent enthusiasm for science. He possessed an imagination that was bold and vigorous in projecting theories—no defect in a scientist, if attended with the conviction that theories must be constantly subjected to verification and modified or set aside in accordance with newly discovered facts; and such was Prof. Eaton's habit of mind. He realized the peculiar uncertainty attending geological speculations; confessed that he had been obliged to abandon numerous errors and to make so many changes in his successive books, as to provoke the charge of fickleness. But he claimed to be ready to abandon any of his views, if further investigation should decide against them. He understood in how incomplete a state he was leaving the science of geology; and in one of his last communications to the "Journal of Science," in 1839, says, we have yet seen only "the *birth*, *boyhood* and *green manhood* of geological science in America."

He lived, however, to see a wonderful and wide-spread interest awakened in the science. Geology became the rage. It was talked on every steamboat and canal-packet, and at every public watering place. Perhaps the fact that Prof. Eaton had had "more than

seven thousand pupils or auditors," had something to do with it. At any rate, at his death, in 1842, every State in the Union, except five, had authorized geological surveys. Massachusetts was the first to publish a report, ably prepared by Edward Hitchcock, afterwards president of Amherst college. Dr. Percival made careful explorations in Connecticut; while the survey of New York was committed to four eminent geologists, Hall, Emmons, Mather and Vannuxem, and in thoroughness of execution surpassed all others. Owing to the wide range of formations in that State and their wealth of fossils, these reports have long been standard authorities in American geology. The true order of the various formations along Lake Champlain was determined; their characteristic fossils were described; and Potsdam sandstone followed by Calciferous, Chazy and Trenton limestones and these by Hudson River slate remain today in geological science substantially as reported in 1842.

Not so, however, with the rocks lying directly east of the Champlain group. Over these arose a memorable controversy which cannot even yet be said to have wholly ended. Dr. Emmons, long professor at Williamstown, in his volume of the final New York report, advanced his theory of the "Taconic System." He claimed that the range of mountains extending from Addison County in Vermont south along the western borders of Massachusetts and Connecticut, and also the limestone and marble on the east of the range, belonged to a formation older than the Potsdam, but younger than the Primitive rocks. In this opinion he was opposed by Professors Hall and Mather, his colleagues in the New York survey, and by Prof. Rogers of the Pennsylvania survey. These regarded the limestones and slate of the Taconic range as belonging to the Champlain group, only altered by heat and more intensely disturbed.

Meanwhile the State of Vermont tardily awoke to the importance of a geological survey of her territory. It was first entrusted to Prof. Adams of Middlebury College, who made several annual reports. But when he left the State, in 1847, the work was left for several years in an unfinished state. It was at length put into the hands of Pres't

Hitchcock, assisted by his two sons and Mr. Albert D. Hager. Their final report, in two quarto volumes, was published in 1861. It presented many important facts and statistics, and indicated fully the geographical distribution of the various kinds of rocks. But little progress was made toward determining the *age* of the formations. Indeed, it is not easy to discover the views of the Vermont geologists in regard to the much-vexed Taconic question, though they report the discovery of certain fossils which seemed to make against it.

Up to this time Prof. Emmons had been decidedly worsted in the Taconic war; but now discoveries were made in Western Vermont which seemed to turn completely the tide of battle in his favor. Though the great weight of authority had been against him, he had only the more stoutly defended his Taconic system in a series of publications reaching from 1842 to 1856. He extended it to include rocks from Maine to Georgia; among them, notably, the black slate on the northwest side of Snake Mountain, just beneath the precipice of red sandrock, and similar slate in the eastern part of Franklin County. Now, in 1860, three strange species of trilobites, discovered in the slates of the town of Georgia by Prof. Zadock Thompson, and figured and described by Prof. James Hall, came under the notice of the great European palæontologist, M. Barrande. He unequivocally pronounced them to be forms characteristic of an age older than the slates and limestones of the Champlain group and as such vindicating Prof. Emmons' views of the Taconic system.

The Canadian geologists now appear on the scene. Other new fossils of about the same horizon are discovered near Highgate Springs, and still more just across the State line in Phillipsburgh, and over a hundred identical or allied species at Point Levis, opposite Quebec. Logan made a most careful survey of the northwest corner of Vermont, and after two or three years reported his conclusions. They were these: (1) That the slates of Georgia, Vt., and the underlying red sandstone (including the Winooski marble) belonged to the same age as the Potsdam sandstone; (2) that above these formations, and below the Chazy and Trenton of the Champlain group, there ex-

isted a formation of great thickness, which he named the Quebec group; (3) that a great fault or crack existed in these strata, in which the rocks to the east were uplifted from one to two thousand feet and thrust up over on to the rocks to the west. This fault passes along the western face of Snake Mountain, Buck Mountain, Philo Mountain, Lone Rock Point near Burlington, and thence along the western shores of the lake into Canada. Then, bending more and more toward the east, it passes through Quebec just north of the fortress and on down the St. Lawrence to Point Gaspe.

These conclusions have stood the test of subsequent research, and may be regarded as established facts in American geology. But Sir William Logan went further. After an examination of the Green Mountain region,he extended his Quebec group in 1866 so as to cover the whole territory. In fact, he pushed his conquest onward through Southeastern New York into New Jersey and Pennsylvania, and also eastward into Maine and New Hampshire. This was indeed only a milder form of the Taconic theory, the only difference being that it came in just *above* the Potsdam and calciferous formations, instead of just *below*. It was a broad generalization, just as sweeping and almost as arbitrary as that of Dr. Emmons. But for a while there was no one bold enough or sufficiently equipped with facts to dispute the views of so high an authority as Sir William Logan.

To overthrow them was the task of a modest, obscure Vermonter, the Rev. Augustus Wing. He was a graduate of Amherst College of the class of 1835. Although not a geologist by profession. he was an enthusiastic student of the science, and a large part of his time for many years was spent in the study of the rocks of Vermont. He rendered substantial service to the corps of Vermont geologists. The later part of his life he gave up the regular work of the ministry, and, being without a family, used to teach school in the winter to earn the means for support during his "geological tramps" in the summer. Many of the older farmers in Addison and Rutland counties will tell you of "old Mr. Wing, who used to be picking around over the ledges" from dawn till dark on week days, but was ready on Sundays to preach

gratis in the school house or the abandoned country church. In 1865 he laid down for himself the task of determining the age of the marble formation in Western Vermont. "Knowing," says Prof. Dana, "that fossils were the only sure criterion of geological age, he searched and he found them, and thus reached safe conclusions." "He accomplished vastly more for the elucidation of the age of Vermont rocks than had been done by the Vermont Geological Survey." "His discoveries shed light not on these rocks alone, but also on the general geology of New England and Eastern North America."

But while all enthusiasm in the field, he was slow in making known his discoveries. His excessive diffidence and aversion to writing had much to do with this; his desire to get further facts and to make his work complete and exhaustive perhaps had more. It was only by a letter from Mr. Billings of Montreal, to whom Mr. Wing had sent fossils for identification, that Prof. Dana first learned in 1872 of the importance of these discoveries. He wrote Mr. Wing for a "fuller account of the fossils of West Rutland." Mr. Wing wrote sixty-two pages in reply, but never finished the letter nor sent it. Prof. Dana visited him in August, 1875, and obtained from him a promise to send for the "Journal of Science" an account of his discoveries. But the article was never sent, and Mr. Wing died the following January.

His note-books and unfinished letters were afterward sent to Prof. Dana, who compiled an account of his discoveries for the "Journal of Science" in 1877 (pp. 332 and 405, vol. xiii). While we are left in ignorance of many important details and of the precise location of many of his fossils, his general conclusion is established beyond all doubt. It is that the limestone formation of Western New England containing the marble is the same as the Calciferous, Chazy and Trenton of the Champlain group, and that the slates of the Taconic range overlie the limestone and belong to the Hudson River and the Utica formations of the New York Reports. The Georgia slates of Franklin County are *not* identical with the slates of Rutland and Bennington Counties, Vt., and of Berkshire County, Mass., as Prof. Emmons maintained and as the Vermont Report represents. The Ta-

conic system of Emmons finally disappears from American geology; while the Quebec of Logan is reduced to a subordinate member of the limestone group, if its existence is to be recognized at all in Western New England.

It only remains to notice the confirmations that Mr. Wing's conclusions have since received. Trenton, Chazy and Calciferous fossils have within the last five years been discovered in the southeastern portion of the Green Mountain area, in the supposed Taconic slates and limestones; and this in many localities by Profs. Dana, Dwight and Whitfield. Prof. Dana has furthermore spent much time during the past seven years in a thorough and detailed examination of the rocks of Western Connecticut and Massachusetts and of Southern Vermont. Though these rocks are much disturbed and metamorphosed, so as to be destitute of fossils, Prof. Dana's labored researches place beyond all question the age of the limestone formation in those regions, and tend to show that the whole Green Mountain range belongs to the same age as the fossiliferous rocks along the borders of Lake Champlain. Patches of older, or "Archean," rocks are believed to occur here and there—reefs and islands in the ancient Silurian sea. Great difficulty attends the detailed elucidation of the central range of the Green Mountains, but we trust Prof. Dana will live to complete his labors. At any rate the age of the marble and the slate has been settled forever.

A brief summary of the *present* theory of geologists in regard to the origin and history of the marble region will help, perhaps, to a better understanding of the character and relations of this invaluable deposit. It is a well-established belief that all the various rocks of this region have resulted from sedimentary deposits in sea water. The sandflats of shallow seas, when hardened by great pressure and heat, become sandstone or glassy quartz-rock. The accumulated remains of shell fish and corals are by the same process changed into limestone or marble, while the fine mud or clay deposited in deeper and more quiet water is hardened into shale, into roofing slate, into

mica slate or into gneiss, according to the degree of heat to which it is subjected.

It is believed, then, that once in the remote past the whole Green Mountain area from the Lower St. Lawrence to the present site of New York City was a gulf or arm of the ocean. At first the tides or currents of the sea were such as to cause extensive deposits of sand over the greater part of this gulf. But certain limited regions were favorable to the growth of shell-fish, where calcareous deposits were made. The mottled marble of Northwestern Vermont represents such a region. The quartz of this period is known as the Potsdam sandstone, one of the best exposures of which is at the Ausable Chasm in Clinton County, N. Y.

Afterward, from some oscillation in the earth's crust and some change in the direction or character of the ocean currents, the waters became more clear and the conditions were most favorable for the growth of lime-producing animals. The sea swarmed with various species of molluscs, crinoids and trilobites, and especially with organisms allied to the corals that are still building continents in the South seas. The calcareous remains of these animals formed beds over the entire region of Western New England varying in thickness from 1,000 to 2,000 feet. This may appear incredible; but it should be remembered that the time was indefinitely long.

This second period was brought to a close and the third initiated by the waters of the sea becoming for some reason turbid. The ocean currents may have flowed across a gradually sinking barrier-reef which existed to the east of the Green Mountain area. The waters deposited their fine silt or mud over the immense beds of shells, and the animals that produced them became extinct. The deposition of fine sand and clay continued for a vast period.

Then came the era of mountain-building. The stages in the formation of the Green Mountains are the same as those of other mountain ranges. The earth's crust is but a comparatively thin shell (perhaps 30 to 50 miles thick) over a white-hot, if not molten, interior. At a depth of 9,000 feet the average heat is enough to boil water; at

a depth of six and one-half miles, enough to melt lead. The natural results of the accumulation of sediment several thousand feet deep along a region where the earth's crust is at the same time gradually sinking in the form of a trough 300 miles long by 50 wide, is, that the interior heat will melt off or soften the underside of the sinking trough, until the region becomes a comparatively weak line in the earth's crust.

At the same time there is a lateral push from the east. For, as the earth is continually becoming smaller from cooling, the external shell must contract or wrinkle to fit it. The wrinkles naturally occur in the weakest places. By a powerful shove, from the direction of the ocean, the horizontal sedimentary beds are tilted up at a steep angle, crumpled together, folded over one another, and thrust high up above the level of the sea. These movements of the rocks under this enormous strain are a source of heat. The bright light of meteors is known to result from the friction of these bodies against the air. So it is proved by exact calculation and experiment that the crushing and shoving of a rocky stratum may raise its temperature to a red-heat. But a less temperature combined with enormous pressure and the agency of super-heated steam would suffice to convert the sediment into the existing rocks. Such, if we may believe the geologist, were the earth-throes by which the Green Mountains were brought forth.

The events thus far described extended over an exceedingly long period and about the same amount of time has since elapsed. During this latter period the Green Mountains are supposed to have held their heads above the waters of the ocean. But even the eternal hills wear away during the lapse of ages. The rain and the frost, the erosion of rivers and the grinding of glaciers have removed a large portion of the original mountains. Wherever the limestone appears it is certain that the entire slate formation that overlay it has been carried off; and where the red sandstone comes to the surface, both the overlying slate and the limestone have disappeared. A glance at our map, or an acquaintance with the topography of Western New

England, shows that the limestone is usually found in the valleys near the water courses; while the higher peaks and ridges are invariably slate, quartz-rock or gneiss. The valleys are, then, valleys of erosion, by which the underlying limestone has been exposed.

Attention should be called to the fact that the same formation appears different in different places. Along Lake Champlain, the more ancient and stable rock of the Adirondack region upheld the sedimentary deposits so that they were less crumpled and less baked by the shove from the east. These rocks accordingly contain abundant fossils; while those to the east and south are nearly destitute of fossils. On the west the slates are clayey and crumbling: but they become harder and more crystalline as one journeys eastward or southward. The gray sandstone west of Lake Champlain becomes the chocolate sandrock of Western Vermont. The purest limestones of the lake region are gray or black from the carbonaceous remains of the shell-fish. But on the eastern borders of the limestone area the same beds are often snowy white, and become more and more coarsely crystalline to the south. At the higher temperature to which the latter rocks have been subjected, the black carbon has been burnt out, just as the fire of the lime-kiln often converts a dark limestone into the whitest of lime.

The process of crystallization, moreover, may be compared to the analogous process of tempering steel. In both cases by a certain increase of temperature and subsequent cooling the molecules are grouped in regular crystals, which can be seen with the microscope and often in the case of marble with the unaided eye.

At the same time the fact remains to be accounted for that in the same region but a comparatively small portion of the lime-rock has been converted into valuable marble. It is not possible to draw the line sharply between a limestone and a marble. Webster's definition of the latter is "a fine limestone, fitted, either when polished or otherwise, for ornamental uses." The best marble results only from a happy concurrence of many circumstances. A limestone may fail to attain the rank of a marble for one or more of the following reasons:

1. It may contain impurities which impart a dull or earthy color. The range of allowable color is wide; but it must be bright and agreeable to the eye.

2. It may contain minerals that are much harder or softer than the lime-carbonate. Silicious or slaty matter is found in most of the lime-rock, rendering it difficnlt to cut and polish. Occasionally great beauty of color may compensate for this, as in the case of the Winooski marble, which is quite silicious.

3. The coarseness of the texture may prevent a pure and beautiful limestone from ranking as an ornamental marble. This is generally the case with the deposits now profitably wrought in Berkshire and Litchfield Counties of Massachusetts and Connecticut for architectural purposes. On the other hand, from a *lack* of crystalline structure the stone may not be susceptible to a good polish. Rutland and Addison Counties are the region where the crystalline structure is at about the right mean.

4. The unsoundness of the rock may be a great practical objection. A jointed structure, or the presence of minute fractures, or a tendency to fracture, is a frequent cause of failure.

5. Lastly, a stone, otherwise excellent, may fail in durability on exposure to the weather, and so be unsuitable for many of the uses to which ornamental marble is put. The crystals that compose it are sometimes but feebly cemented together and the stone crumbles or furnishes an easy foothold for lichens. Many impurities, not otherwise objectionable, dissolve away after a while, producing a stain, or, existing as separate crystals, become detached, leaving a cavity. Or sometimes the lime-carbonate itself dissolves away faster than the impurities and the stone "weathers" to a dull or dingy color.

Of the immense formations of limestone in Western New England (1000 to 2000 feet in thickness), the lower portion known by geologists as the Calciferous (300 to 400 feet in thickness), is for the most part silicious, partaking of the nature of the sand-rock that underlies it. The upper portion, known as the Trenton (500 to 600 feet in thickness), is impure from the presence of clayey matter, partaking

of the nature of the slate formation that overlies it. Only certain layers of the middle portion seem to have been fitted by their original constitution for the production of marble. These strata in Rutland and Addison Counties appear in two parallel lines, about two miles apart, stretching from the North line of Middlebury to the South line of Rutland, and are from one to two hundred feet in thickness. This deposit bids fair to remain in future the chief source of ornamental marble for the continent.

The accompanying map is compiled from the geological surveys of the States of Vermont and Massachusetts and from Professor Dana's Manual of Geology.

Split Rock Mountain on the west shore of Lake Champlain represents the peculiar rocks of the Adirondack region. A quarry has been recently opened in this mountain and the stone is known as "Champlain granite." But it is not a true granite. It consists chiefly of black pyroxene and lime-feldspar. The rock belongs to the "Archean Age," the oldest recognized in geology. Professor Dana considers the area surrounded by the limestone and sandstone in Northwestern Connecticut to be of this Age.

The portion of the map colored red is where the rocks of the Potsdam period come to the surface. The blue shading indicates the outcropping of the limestone and marble of the Canadian and Trenton periods. The uncolored portion of the map, except the vicinity of Troy, indicates the quartzite, the gneiss and the various slates of the latter part of the Trenton period.

THE MARBLE FIELDS

AND

MARBLE INDUSTRY OF WESTERN NEW ENGLAND.

BY PROF. HENRY M. SEELY.

THE belt of marble already mapped and sketched, so interesting on account of its geological character, has still other claims to our attention. For nearly a century it has been the seat of an industry, which, in these later years, is becoming one of vast importance; and the region is marked by a line of active or suspended quarries throughout almost its entire extent.

Our hasty run over the field from north to south, a stop at some of the most important localities, inquiries about others, and additional information from various sources, have put us in possession of facts which seem to be worth recording. and to which I now wish to call your attention.

A rapid glance at the present condition of the industry will prepare us for further historic and practical details of the work.

Beginning at Middlebury, near the utmost northern limit of the belt of white marble, in the northeast part of the town will be found a quarry which, with its mill and finishing shops, has been in operation the past year. This property, known as the Cutter Marble quarry, has passed through many vicissitudes and through many hands. Theodatus Phelps built the first mill with an undershot water-wheel and a single gang of saws. David Ralph succeeded him and did a prosperous business in the making and sale of thresholds, window caps, and grave stones. Following Ralph were Ira E. Yale and Abel Spaul-

ding, and then Isaac Gibbs, who also furnished the country about with building lime burned from the refuse fragments of his quarry. Then the property passed to Dr. Datus Garlick and Mr. A. J. Severance, and from them to the possession of a company of Boston gentlemen, Mr. Cutter taking a large financial interest.

The enterprise of making a new opening some distance south of the old quarry, which has afforded much beautiful architectural and monumental marble, has been undertaken with fair promise of success.

A little farther north, at Belding's Falls, marble obtained at various localities is sawn, while openings in the immediate vicinity are now being pushed with good expectation of success.

A little to the south of the Cutter quarry is that known as the Addison County quarry, which has a history much like that of the Cutter. This reaches back to the time of Judge Doolittle and Rulof Lawrence. Work here for the present is suspended, but in the estimation of marble workers of much experience the property is of great value.

The Foot Street quarry is three-quarters of a mile south, in the same range of the deposit and of similar quality. Large sums have been expended in the development of each. They are held as yet by men able to retain them, but the inducements of accessibility, extent, unrivalled purity and beauty of the finer layers cannot always be neglected.

Going south from Middlebury the ledges of gray limestone of Salisbury and the lime-kilns of Leicester keep one informed as to the character of the rock over which he travels. Brandon and Pittsford are passed by and reserved for a later personal visit. This, however, may be mentioned in the passing, that Brandon has at least two quarries in active operation, while the marble interests of Pittsford are rapidly assuming large proportions.

The southern border of Pittsford joins the town of Rutland, and its marble beds are one with those of Sutherland Falls, or Proctor, as this place is to be appropriately known in the future, which is a portion of the town of Rutland.

To one unacquainted with the working of Vermont marble, the Sutherland Falls quarry opens like a revelation. *This* wonderful sight occurs, that of a hollow cube cut into a hill with perpendicular walls on the north and west rising to the height of near one hundred feet, open to the sky, and with an acre of rock forming its horizontal marble floor. Over this floor are running channeling machines, cutting deep, narrow furrows into the solid stone. Long parallel blocks of stone are thus made; these are cut across into more nearly cubical forms, loosened from their bed, and lifted from the quarry, to be wrought up here at the Falls or elsewhere into finished marble.

The mills have great capacity. Sixty-two gangs of saws are in operation night and day, and additional buildings are being erected to meet the increasing demand for the sawn marble.

Finishing shops are in active operation, putting into final shape both architectural and monumental stone.

The various departments of labor at the Falls give employment altogether to about five hundred workmen.

West Rutland, with its many quarries, has given, these later years, the reputation to Vermont marble that has made it famous. While the marble of Sutherland Falls is clouded or mottled, much of that quarried at West Rutland is pure white. The strata here have been followed at a sharp dip and in one quarry to the depth of two hundred and twenty feet. The abyss made by the huge long slit into the rocky earth, when filled with ascending smoke and steam from the engines at work below, seems bottomless. This great opening is partly covered over by the overhanging rock; in the winter it is sometimes further protected by a wooden roof.

Intense activity is here exhibited both within and without the quarries. All the appliances for turning out the manufactured marble, mills, finishing shops and the like, are here seen.

One going south of Rutland on the railroad still follows the line of marble. The towns of Clarendon, Wallingford and Danby are passed without any evidence of active quarrying operations. At Dorset, however, the aspect changes. Dorset Mountain, or Mount Eolus, as

Prof. Hitchcock named it, is a mountain of marble, the top bearing a cap of slate. Here in different localities are situated several quarries, worked mostly in the summer time. Early in April, as we passed, the work of the year was not sufficiently advanced for satisfactory observation, so the locality was reserved for future study.

The remaining towns south, in Bennington county, offer no present inducement for delay, and we pass over the border of Vermont into Berkshire County, Mass. North Adams near the Northern line of Massachusetts was early noted for its beautiful white marble. The quarry near, but at an elevation of 250 feet above the village, is no longer worked for marble; the whitest of the coarsely crystalline rock, however, is selected and ground into marble dust.

Still south on the marble belt are the towns, Lanesborough, Pittsfield and Lenox, but in these no quarry is in operation.

At Lee extensive quarrying for architectural marble is going forward, a force of upwards of sixty men being employed in the work. A mill with four gangs of saws is in operation, but most of the stone is shipped to Philadelphia in the block.

The towns, West Stockbridge, Alford and Egremont, are on the range and at former times have produced marble. None now is raised. Near the village of Great Barrington a beautiful stone called *blue stone*, which is worthy of more than local note, is taken out in moderate quantities for architectural purposes.

Further south, is the town of Sheffield, which at one time had a reputation for its immense blocks of marble, which with great labor were carted across the hills to the Hudson river, whence they were shipped to Philadelphia. This industry ceased at this point years ago.

From Sheffield the line of marble holds on its course southward into Canaan, Litchfield County, Conn. At East Canaan within a few years large quantities of marble have been taken for the State house at Hartford. Derricks are still remaining at the pit, but the quarry is now unused.

Passing through Cornwall and Kent, one reaches New Milford, a

town rich in historic interest, which is still holding its marble quarries, though they have been abandoned thirty years.

Farther to the South and West the line of Calcareous rocks runs on into New York, but it is not the present purpose to follow it beyond the borders of New England.

Having taken a hasty run over the region and a glance at the present condition of the industry, it may be proper to return more deliberately over the ground and notice on the way some matters in connection with the history and progress of the work, something about methods, improvements, amounts, and values, and some facts having relation to the geology of the region.

Historically, Marbledale, in the town of New Milford, Conn., has a right to claim first mention. Here near the date 1800 Philo Tomlinson was at work quarrying marble and sawing it into slabs. He had come up the Housatonic valley from Derby in the same State. One may still find at the spot where he located his first mill the remnants of machinery and among them the decaying apparatus by which sand and water were distributed to the saw similar to that for which he received a patent.

Orcutt's history of the town of New Milford fixes the date of early operation pretty clearly, and the correctness of this date is further established by the headstones in the graveyard at New Milford. The oldest of these are mostly of sandstone from the Connecticut Valley, made picturesque, but almost illegible, by the covering of lichens. Those of slate, of nearly the same age, hold their lettering much better. The earliest marble headstones were evidently those which had been separated from the rock in the quarry by hand drilling and wedging, and then worked down by hand. But those bearing a date soon after the beginning of the century were cut on one or on both sides by a saw.

Although future search may carry farther back the date of the invention of the various pieces of machinery useful in working marble, to Tomlinson of Marbledale must be accorded the credit of combining these in a serviceable form, and applying them successfully to his

purpose in sawing marble. He used soft-iron toothless saws, stretched in a frame forming a gang, the gangs were driven by water-power, and the saws were fed by sand and water, equally distributed by an automatic arrangement.

The *Serra* used by marble workers in the time of Pliny and centuries before was a toothless saw fed by sand and water. But the saw was drawn by hand.

Water-power was used in Germany for sawing stone as early as the fourth century, but this mode of sawing seems to have fallen into disuse and to have been forgotten. Near the year 1730 William Colles of Kilkenny, Ireland, restored and put into use the process of sawing marble by water power, and here at Kilkenny it has been continuously in use down to the present day.

The Irish chronicler, William Tighe, in 1800–1802, noticing this industry in Kilkenny, states: "The principal work is done at the marble mill which is on the left bank of the river (Nore) near two miles from Kilkenny. This mill is admirable for its simplicity." The same machinery drove both saws and polishers. An account of this mill was published in London in the year 1748, in which the writer of a "Tour of Ireland," states: "I cannot learn that any one has attempted to imitate this machinery. It is perpetually at work, by night as well as by day, and requires but little attendance."

The saws here used were of soft iron, and were at first and for a long time after all single blades, not working in a gang.

A knowledge of the process apparently went over to Derbyshire, England, for in the year the "Tour of Ireland" was published, works similar to the Irish were established. The English authority, Tomlinson, in his book on the Useful Arts, says: "The principal marble manufacture of England is in Derbyshire, along the valley of the Derwent and the Wye, from below Buxton to Derby. The machinery for sawing and polishing was first established at the village of Ashford, near Bakewell, in 1748, water being the motive power. About 1810 similar machinery was erected at Bakewell. Both works are situated

near the quarries." Here, as elsewhere in England, the machinery for polishing is similar to that for sawing.

Several saws stretched in a single frame, thus forming a single gang, was a device which may have been used many years ago. Leonardo Da Vinci figured such a gang on a small scale, as is shown in Mr. Clarence Cook's article on that painter in Scribner's Monthly, Vol. XVII., p. 343.

Yet with the present information it does not seem to have been in general use until after Philo Tomlinson's application of it at his mill at Marbledale.

The industry flourished at Marbledale where it originated. Quarry after quarry was opened and mill after mill erected on the banks of a small stream, the (East) Aspetuck. In 1830 as many as fifteen quarries were actively worked, and a like number or more mills were in operation within a distance of less than three miles, and the marble went to all parts of the country.

Soon after this date competition from other localities, especially from Dover, N. Y., and Rutland Vt., began to cause a decline in the profits of the work. This competition increased, particularly from Vermont, the work became unremunerative, and near 1850 the Goodsell quarry, one of the principal—and last in operation—was abandoned. The sawing likewise declined until at present a single mill at the village of New Preston, doing local work, is the only existing representative of the industry.

Why the work, so well established, was compelled to give way to competition may not be plain at first view, but the cause will be mostly explained on the examination of the rock in place. The strata at Goodsell's quarry are at a sharp dip, not quite perpendicular, while the beds affording the best marble are not thick. Much unproductive stone must be removed, rendering quarrying expensive. The rock is not a pure calcareous marble, but magnesian, and through some portions minerals like tremolite and asbestos are found. The white rocks not far away from the quarries are breaking down into a white sandy mass, showing that the material does not weather well. To the char-

acter of the rock, not yielding massive blocks, and the lack of enduring quality may be largely charged the failure of the industry.

In the northern part of Litchfield County near the Massachusetts line is the town of Canaan, and at East Canaan is the quarry that furnished the marble for the new State House at Hartford. The rock lies in massive beds, near the surface, and is apparently in vast quantity. The rock is white and coarsely crystalline, contains in some portions of it many crystals of tremolite, and though not suitable for monumental uses, is fitted for the purpose of building to which it has been put. Large blocks can be obtained, and one may expect that the work which has been stopped will be revived. Derricks are still standing, indicating the recent abandonment of the quarry. The remains of the large steam mill may be seen; the mill itself, however, has been burnt to the ground.

The saws used at this mill were peculiar in this, that they were toothed with diamonds. The carbons were set in pieces of steel or iron, and these patches were brazed into the blade of the saw. It is reported that they were wonderfully effective, sawing the blocks of marble very rapidly.

The conjecture is made that the East Canaan quarry closed work because the contract for which it was opened being completed, there arose at that time no farther demand for marble of that quality.

Sheffield, Mass., adjoins Canaan, Conn., and has had several quarries in operation. The quarry in the north part of the town, from which the large columns for Girard college, Philadelphia, were obtained (1838–1841), was noted for its thick strata, and from these blocks sometimes fifty feet long were blasted out. The use of gunpowder in removing blocks from the quarry is not often commended, but with the care exercised in this case its operation seems to have been quite satisfactory.

The same marble range extends through the eastern part of Egremont and Alford, but the quarries in these towns, like those of Sheffield, have been abandoned.

A quarry of clouded marble was at one time, 1828, opened in the

town of Great Barrington, but is not now worked. But in two or three localities near the village there are quarries of the *blue stone* previously mentioned, which, if found to weather well, ought to find favor among architects. It has been used in the construction of a public building at Pittsfield, with excellent effect. The new church and rectory in Great Barrington are of this stone, as are other structures, as the Berkshire Hotel, built years ago. There is a warm and cheerful look about these buildings, such as does not characterize those constructed of white marble. The character is largely a crystalline magnesian limestone, but it carries with it many grains of quartz and iron pyrites. The grains of pyrites are mostly microscopic and compact, though in some pieces the quantity is so great as to be notably evident. This ingredient may interfere with its usefulness, but no staining nor decay was observed in the strucures which we hastily examined.

Stockbridge, West Stockbridge and Lee lie north of Great Barrington and are on the range, though the limestone is in some places overlaid by slate, apparently dividing the rock into various fields. The quarries at West Stockbridge and Lee are those which are most worthy of note, the former for its early history, the latter for its present products.

A firm, Newell & Cook, as early as 1802 erected a stone saw mill at the "old quarry" below West Stockbridge village. It is well established that the same persons had a mill in the village certainly as early as 1803, and with great probability a year or two earlier; so the industry of sawing marble here, as well as at Marbledale, began at the beginning of the century.

In November, 1803, Johnson & Stevens concluded a contract for furnishing the marble for building the front of the New York City Hall (1803–1811), having early in the year bought a tract of land on which was opened a quarry, later known as the Fitch quarry, which by a change of town lines is now in the town of Alford. Under this contract over 33,000 cubic feet were delivered at a price of $1.06 per foot. Later, that is, in 1808, the same firm filled another contract of

2,000 feet at $3.00 a foot, the stone at this time probably coming from the old quarry.

How valuable the stone was for building is shown by the fact that after an exposure of more than three-quarters of a century it is practically without sign of crumbling or decay. The extension of the capitol at Washington is from marble obtained at West Stockbridge. The quality and beauty of the marble, useful for monumental as well as architectural purposes, brought it a most desirable reputation and orders for it came from all parts of the country, East, South and West.

Berkshire County produced in 1824, according to the estimate of Prof. Dewey, marble to the value of $40,000. The produce of 1839 Mr. Chas. B. Boynton estimated to be $200,000.

The demand for the West Stockbridge marble was much ahead of the supply. Under this stimulus the mills were kept running night and day. Later, steam was tried in sawing, but on account of the expense, which was asserted to be 28 cents per foot,against 5 cents a foot by water power, it was abandoned.

Chas. B. Boynton introduced several appliances which at the time were thought to be very helpful for quarrying and dressing the marble here. He revived the process invented by Misson, and used more than a century before in the marble quarries of the Pyrennes, of cutting the blocks from the rock by saws. Misson used saws over twenty feet long. Boynton's saws are not described, but he had the advantage of his long-time predecessor in having steam at his command, which he used in driving his saws.

A method similar to that employed at Sheffield for getting out large blocks was used to some extent by Boynton at his quarry in West Stockbridge. A trench was cut at each end of the block to be removed, and also on the under side; drills and long wedges were then used on the under side,and, with the aid of a light charge of gunpowder, the whole was loosened. He also invented and used for years a machine for planing marble, by which not only plain surfaces could be cut so smooth, that for ordinary purposes, no further polish-

ing was required, but also straight mouldings and grooves could be cut with great facility and exactness.

At one time seven sawmills were in active operation in West Stockbridge. Fortunes, in those days considered large, were accumulated in the business.

The rock in its best layers is nearly a pure calcium carbonate. These layers dip, as do most of the marble strata, to the East. The old quarry pitches under the West Stockbridge river and has been worked for some distance under its bed.

Quarrying stopped here near 1855. Freedley's mill is still standing. Blocks of marble are piled upon each other by the side track of the railroad, waiting for transportation. But the machinery of the mill has gone into decay, while the decrepit derrick would break its spine in attempting to raise a block to a car.

The cause of this stopping of the work was sought for. Major Robbins (aged 87), who saw the quarry and mill in 1804, who witnessed the rise, growth, maturity, decline and extinction of the industry, (1804–1850), he himself having had a large part in the work, gave tersely a full answer to our inquiry by saying, "Quarrying stopped at West Stockbridge because Italian and Vermont marbles were better and cheaper."

The quarry at Lee has escaped the decadence that has fallen upon those of other towns in Massachusetts. The life of the quarry is evinced by the stroke of the drill, the puff of the steam engine and the stamp of the channeling machine. The thick strata are quarried under the open sky from a nearly horizontal floor. Six channeling machines are at work preparing the rock to be loosened in blocks. A diamond "gadder" is also used. Steam is used in the mill for sawing as well as in the quarry for driving the channeling machines.

The stone is not suitable for mantel or monumental purposes, but is quarried wholly for buildings. Philadelphia, a city demanding much marble for its public edifices, furnishes the largest market for the product of Lee's quarry. The large blocks are often pitted with tremo-

lite—dog teeth, in the language of the quarrymen—reminding one of the stone from East Canaan, Conn.; while the mass is not pure calcium carbonate, but a dolomite. Lime is burned near the quarry, but the stone is not obtained from the same beds as those furnishing marble.

The towns of Lenox, Pittsfield, Cheshire, Lanesborough, New Ashford, Adams and Williamstown, all have a share in the marble belt and some of these early shared in the prosperity of the industry. Particularly was this the case with Pittsfield, New Ashford and Lanesborough. From Lanesborough was obtained the marble used in the construction of the old capitol building at Albany. The rock is represented to be of fine grain and good quality. Lack of conveniences for transportation has been suggested as interfering with the successful working of the beds.

The rock at North Adams, though of good character chemically, is too coarsely crystalline, as before stated, for a good quality of ornamental marble, while the beds are not massive enough to give large blocks for architectural purposes. The rock is perhaps best economized by the use to which it is now put, that of pulverization, by which a beautiful marble dust is produced.

Including East Canaan quarry close adjoining Berkshire, from which the handsomest State capitol in New England was constructed at Hartford, 1878, that of Sheffield, furnishing the columns of Girard College; Lee*, the material for the extension of the capitol at Washington, 1867, and for the City Hall now building at Philadelphia, West Stockbridge leading all others with the New York City hall, 1803–11, the most conspicuous public contracts have been supplied from the deposits in Berkshire county, neither of which in any sense has been exhausted. Other industries may compete for its capital, employing cheaper labor, but science recognizes a debt of gratitude to its seat of learning, as do art and society to nature in its valley.

* A correction appears here of an error on page 32, crediting West Stockbridge with the national preference mentioned.

Approaching the localities at which the business of quarrying marble has centered these late years we come to Dorset, in Bennington County, Vermont. The quarries in this town are situated mostly up the sides of Dorset Mountain or Mount Eolus.

It is stated, with much truth, that this mountain is a mountain of marble. But it must not be inferred that it stands out as a pure block of marble and can be cut into anywhere and remuneratively quarried. Many of the strata are silicious and of too hard texture to be worked, others are slaty and fragile, some are magnesian and some are ferruginous, while in some places, layers of quartzite and in others of slate seam through it. Comparatively, but a small part of the mountain furnishes merchantable stone, and yet this small proportion is in the aggregate immense.

As one ascends the mountain he finds most of the rock obscured by debris, making it difficult to observe with certainty the real sequence of the different strata.

He will pass beds of variable character, reach the compact and fine-grained marble, higher find the beautiful white and more coarsely crystalline stone, still higher, the gray interbanding with white, then the gray carrying many crystals of pyrite and films of hydromica slate, then he will miss the limestone altogether, which disappears under a debris of comminuted rock, over which have fallen many blocks of slate. Higher still are masses of slate, seamed in many places with milky quartz and by this slate the top of the moumtain is covered.

This cap of slate Hitchcock estimates to be 498 feet thick and the limestone with the marble below 1970, the whole a total of 2468 feet for this wonderful mountain. The actual junction of the slate with the limestone, here, as at almost every point throughout the whole marble range, is obscured by debris.

The gray lime-rock beneath the slate, impure with crystals of iron pyrites and grains of quartz, together with intershaded lines of hydromica, calls to mind the blue stone of Great Barrington, though this rock is more slaty in character. The pyrite and hydromica accompanying this stone give favor to the conjecture that to the decompo-

sition of this rock and the adjoining slates are due the deposits of iron ore and kaolin, which so generally border the slate belt and attend the deposits of marble.

Lower down, after passing the banded white and gray limestone, is reached the seamy, easily-quarried marble, coarsely crystalline and white. Flag-like layers here afford slabs suitable in thickness for headstones and the early supply of marble here came from such strata. Deeds for such quarrying property date back before the present century. From one hundred and fifty or two hundred feet below the slate the white architectural marbles come in; and near four hundred feet lower the fine-grained marbles useful for ornamental and cemetery purposes are quarried. Below this the rocks are mostly too variable in character to yield valuable marble.

The strata here wrought do not have a high dip to the east, as is almost always the case in marble quarries along this line, but are horizontal or gently undulating.

The first quarry opened in Dorset—following the authority of Mr. F. Field in the Vermont Gazetteer, 1861—was by Isaac Underhill, in the year 1785, on lands then owned by Reuben Bloomer and still held by the Bloomer family. The quarry was first wrought for fire-jambs, chimney backs, hearths and lintels for the capacious fireplaces of the day. People came a hundred miles for these beautiful fire-place stones and considerable trade in them soon sprung up. Other quarries were soon in operation and from 1785 to 1841 nine quarries were opened. The first marble gravestone ever finished in Dorset, it is believed, was the work of Jonas Stewart, in 1790, from a slab taken from the Bloomer quarry. Active manufacture of marble headstones seems to date from 1808, when Elijah Sykes opened his quarry and gave his chief attention to this business. The stock was taken from the top or outer edge of the layers where the strata could be readily split into sheets or flags of a thickness of four inches or so. These sheets were then cut down with mallet and chisel to the desired shape.

Marble was first sawn in the town at South Dorset in 1818 by Field and Booth. When this method of sawing was well established

the former sources of inferior marble were abandoned and better stone used. This sawn marble found a market in New York, Boston, Philadelphia, Cleveland and at intermediate points. In 1840, before the introduction of Italian and Rutland marble, the demand for Dorset marble was beyond the supply.

Various quarries are in operation upon the mountain. At South Dorset fine monumental stock is obtained at the quarry of Kent & Root. Channeling machines and rock drills with a force of perhaps sixty men are at work. A mill with eight gangs of saws is in operation.

S. F. Prince & Co. are working a quarry higher up the mountain with a force of about thirty men. From this a beautiful building stone, both of white and bluish shades is obtained. A part of this stone is shipped directly to Philadelphia in blocks, part sawed at the mill not far away and and another part at their mill at East Dorset. The annual product may be set down at from 30,000 to 50,000 cubic feet.

Up the mountain at East Dorset, the Dorset Marble Company is working what is known as the Vermont Italian marble quarry. The stock here produced is used almost exclusively for monumental and decorative purposes. Some of the tiers, of which as many as twenty are recognized, afford very beautiful mottled and clouded marble. The quarry was worked forty years and more ago. Masses of rock of immense size are moved or thrown down by a blast and then worked into manageable blocks by hand or machine drilling. The blocks are carted down to the mill, where twelve gangs of saws cut the stone into desired shapes. An annual average of 31,000 cubic feet is produced.

The Freedley quarry, farther to the north and nearer the slate, has been worked since 1820 and is still producing an excellent quality of building stone, white and firm. In color and texture it reminds one of the North Adams marble, though the rock here at Dorset is not so coarsely crystalline. On account of the great amount of overlying rock, tunneling has been done here on a large scale, the quarry being

only partly open to the sky. Large columns of undetached rock are left to support the roof. The excavations indicate that great quantities of material have been removed. About twenty-five men are employed at the quarry and half as many more at the steam mill, with its ten gangs of saws, at the foot of the mountain. The quarry is near 1150 feet above the base of the mountain, and the blocks, instead of being carted to the mill, are sent down an inclined railroad, an empty truck being drawn up by the descent of a loaded one. The stock, amounting to an annual average of 40,000 cubic feet, when sawn, goes to Philadelphia.

One may pass from Dorset north along the line of limestone and marble, which is dotted here and there with unproductive and abandoned quarries, and find in the town of Rutland, in the county of the same name, quarries which have given name and repute to Vermont marble. These have not the early history of those of Dorset and Middlebury, but were opened at the time when the tide of remunerative work in Connecticut and Massachusetts was at full flow. The abundance and excellence of the marble of Rutland brought it into successful competition with that obtained in the two States farther south. Twenty years of struggle left the proprietors of these quarries in possession of the market for the finer varieties of American marble. A prosperity has been reached which nothing but an unforeseen calamity, or condition of affairs, can seriously affect.

West Rutland is the locality from which the fine white marble of the range is obtained. Pittsford, Brandon and Middlebury hope to compete in the production of marble of this quality, but actual competition must be yet in the future. The year 1838 marks near the early period of successful work, though it was not until about five years later that William F. Barnes, whose name will always be associated with the history of the development of Rutland marble, began his work upon the quarry, which in connection with others has made this marble famous throughout the whole country.

Here, upon the western slope of a range of low hills running north and south, is found the "Rutland marble." The strata have a dip to

the east varying from 25 ° to 85 ° with an average of 45 °. The thickness of the beds wrought is from 50 to 110 feet and these have been followed to a depth of 220 feet. The strata have many marked and distinct layers, varying in color, texture and value. White, clouded and blue are the prevailing marbles; the white, fine-grained, statuary marble being the most valuable.

Full statistics are not at hand indicating the number of quarries and the force employed. Approximately the number of quarries may be set down at fifteen, and the number of men engaged about the quarries, mills and shops at two thousand.

The methods of quarrying at West Rutland are like those in other places and will be described further on. Steam is the power used in the mills as well as in the quarries.

The ingenious device for automatically distributing sand and water to the saws in the marble mills, which was invented by Philo Tomlinllnson of Marbledale and used in the mills there the first half of the century, seems to have fallen out of mind. In most of the mills one man is still required to attend two gangs of saws, keeping up the supply of sand and caring for its proper distribution. Recently other methods have been proposed. One just introduced at West Rutland is a simple elevator arrangement of band and buckets. By means of this one man will be sufficient to superintend six or eight gangs.

A successful application of the "sand blast" in cutting marble for monumental purposes was made at Sheldon & Slason's works at West Rutland, about the years 1875–1876, in preparing headstones for soldiers' graves at the national cemeteries. Similar work has since been done at other localities, but on a smaller scale.

The blast of sand upon marble rapidly wears it away, but if a portion of the surface be protected from the chiseling action of the sand, that part will soon stand out in relief. By using the ingenious process perfected by Tilghman the work was rapidly and cheaply done. The parts of the stone to remain uncut were protected by an iron shield, while letters and figures of chilled iron were placed upon the spaces where the inscription was to be raised. The blast of sand, turned on

to the prepared stone, would eat away the unprotected part, while that protected would rise up in high relief out of the block. By this method, the name, company, regiment and rank of a soldier could be put upon a stone in less than five minutes of time. Contracts were filled by which 254,000 lettered headstones, having dimensions of three feet in length, ten inches in width and four inches in thickness, were placed in the national cemeteries at an expense to the government of $864,000. The economy of the process alone made it possible to place these monuments at the soldiers' graves for so small an amount.

The stone has been thought too soft for statuary purposes, though some layers have been used with great satisfaction for this purpose. At the State House at Montpelier may be seen the statue of Ethan Allen of heroic size. This statue was cut by Larkin J. Mead, and appropriately from Vermont marble, the quarry at West Rutland furnishing the stock. While, from its softness, the marble from these quarries cannot carry as fine lines as the Italian, still it stands exposure to the weather better. The layers, too, are growing harder as they are followed into the earth, and some of them are about as hard as the foreign.

Before reaching Sutherland Falls, still in the town of Rutland, there is to be found the quarry of the Columbian Marble Company. The marble here is of a peculiar character, variegated and almost black. This has obtained an enviable reputation for mantel and monumental work, and from its fineness and hardness stands at the head of the list of dark marbles.

The extent of the quarry at Sutherland Falls has been already alluded to. The marble is of the clouded variety. Some beds opened in the vicinity are much like those that further south furnish the Columbian marble and farther north the Mountain dark.

It would be interesting to know the origin of these mourning marbles in which the white and black are so curiously mingled. The material giving the black appearance is assuredly carbon, and probably in character approaching the graphite which marks the coarsely

crystalline limestones of the Adirondack region. When freely exposed to a high heat the dark color disappears, leaving a white lime.

A conjecture might be ventured that the rock was originally of different chemical composition in these different parts; in the white the oxidation of the carbon was complete during metamorphism while in the dark the oxidation was interfered with. A second conjecture would be that during the metamorphosis the particles of carbon moved together and became aggregated as in the Adirondack marbles. The first suggestion is supported by the actual difference in the character of the dark and white portions, the former carrying with it insoluble silicious minerals.

A further thought suggests itself, whether the darkly-mottled marbles will not be found to be a metamorphosed Black River limestone of the New York geologists.

The Sutherland Falls marble in general resembles that of Dorset, known as the Vermont Italian. Its veining, however, is peculiar to itself. Two of the most valuable layers are known as the mourning veins, the dark and the light. The dark mourning vein has a ground of deep blue, while lines nearly black run through it in a zigzag course, presenting a very beautiful appearance. The light mourning vein has like irregnlar lines, but the ground is nearly white. Both these layers are free from flaws and receive a very fine polish. The folding of the strata, the further crumpling and compacting of the original layers have left here a mass of marble unique in character. Not only is the mass great in volume, but from the apparent plastic condition at the time of metamorphosis, the lines which would be those of bedding in most quarries have nearly disappeared, those remaining forming graceful veins and ever-varying clouds.

The quarry was opened here near 1836, though not vigorously worked until some years later. The situation gives it peculiar advantages. It is on a gentle height above the railroad and mills, and when the blocks are placed upon the trucks they will readily descend to the landing place.

The falls of the Otter here offer an immense water-power, which

power is admirably economized. The saws in the mills, the polishing beds and other machinery of the finishing shops and even the drills in the quarry are driven by it. For work in the quarry the air is compressed by water-power and conducted in an 8-inch pipe about half a mile away. There would be no gain in using compressed air in an open well-ventilated quarry if steam were necessary for the compression. Really there would be a loss of power amounting to about 40 per cent. But here, as the falls afford so much surplus power, compressed air is exceedingly economical and effective.

The mechanical appliances as well as the power used at Sutherland Falls are worthy of notice. Some of these have already been incidentally alluded to. It is by the introduction of channelers and power drills that the profitable working of compact ledges of rock is carried forward.

An early view of marble quarrying would give us the sight of a few men, perhaps spared for a little time from the labor of the farm, working away with drills and wedges, at thin-bedded and easily-separated layers of marble. With these slabs, almost ready made, the local market would be supplied.

Twenty-five years ago this glimpse of quarrying at West Rutland was given: "It is an interesting scene to behold two hundred quarrymen ranged in rows, each with his long sharp drill, steadily cutting deeper and deeper those grooves that are destined to sunder the fetters that bind those valuable blocks to their parent bed. The musical ring of the quarryman's drill, that reverberates to the ear, from the deep-vaulted quarry, is pleasing to the spectator, as he stands and looks down into it; and to the proprietor it is the welcome harbinger of the 'good time coming,' for a successfully wrought quarry is quite sure to bring fortunes to the proprietors."

To-day the view of quarrying is entirely different. The statement of profit we may assume to be as true as when the above was written, a quarter of a century ago, but the description of the method will not fit. The introduction of power has changed the aspect of the quarry, the musical drill being now used only as accessory. The

preparations for loosening the blocks from the quarry are mostly made by machinery. The champ of channeling machines and the noise of steam engines driving the diamond drills are harmonious only in the distance. What, however, has been lost in music, by the passing away of the old method is more than made up in the efficiency and economy of the new.

These aids to the quarryman may be properly mentioned at this place, since Sutherland Falls has seemed to be the pioneer point for cutting machines.

The channeling machine manufactured by the Steam Stone Cutter Company of Rutland, Vt., was invented by George J. Wardwell of Rutland. The first successful machine was built by him in 1863, in connection with the Sutherland Falls Marble Company, and that original machine has been at work there constantly until within a few months. These machines are now in operation in almost all of the important quarries in the country, and it is calculated that over 5,000,000 square feet have been cut by them. The channeler is essentially a locomotive machine driven by power, usually steam, moving over a steel rail track which is placed on the quarry bed, and carries a single gang drill on one side, or two such drills, one on either side. These drills are raised and dropped by a lever and crank arrangement. The gang of cutters forming the drill is composed of five steel bars, seven to fourteen feet long, sharpened at the ends, and securely clamped together. Of the five cutters, two have diagonal edges; the other three have their edges transverse. The centre of the middle, largest, extends lowest, so that the five form something like a stepped arrangement away from the centre. The drill, lifted, drops with great force, and rapidly creases a channel into the rock. The single machine is operated by two men, the double by three. As it runs backward and forward over the track the machine is reversed without stopping, and as it goes the cutters deliver their strokes, it is claimed, at the rate of one hundred and fifty per minute. The machine feeds forward on the track half an inch at every stroke, cutting half an inch or more every time of passing. The single machine will

cut from forty to eighty square feet of channel in marble or limestone per day, and at a cost of from five to twenty cents per square foot. The double machines will do twice the amount of work.

A good workman would formerly cut from five to ten feet—that is a groove one foot deep and from five to ten feet in length—per day. For this he would receive from 20 to 30 cents per foot.

Diamond drills have been used in England and France many years for cutting stone. Two general kinds have been in use, one for prospecting—the diamond core drill—a second, used for actual work in the quarry and known as the Solid-headed Diamond Drill.

The Sullivan Machine company of Claremont, N. H., manufacture most of the machines of this kind that are used in the marble quarries. The diamonds, or *carbons*, as they are called, are so arranged upon the face of a cone-shaped metallic head, or bit, as to cut a circular space corresponding in diameter with that of the drill bit. This bit is fastened to the end of the drill rod, or spindle, which is rapidly revolved and at the same time fed forward into the rock. A machine may have one, two or three spindles. Five hundred revolutions a minute and five inches linear distance for the same period is fair work for each drill. Water is forced through the drill spindle, and head, to wash out the borings and to keep the drill-head from heating.

The machine known as the *gadder* is a single spindle machine used in boring holes preparatory to raising the blocks. When the requisite channels are cut about the blocks to be removed, it is necessary to gad or undercut the block, in order to loosen it. This is done by drilling a series of holes beneath it, and then, by wedging, the block is split from its bed. This gadding was formerly slowly done by hand, but now the gadder is used and does the work as rapidly as perhaps twenty men. The first gadder made by the Sullivan company in 1869 was put into operation at Sutherland Falls. Afterwards machines were made which carried two or three drills running at the same time, one so arranged as to bore holes which connect, and make an open continuous channel. These are especially serviceable in cutting inclines and tunnels.

The high price of carbons for the past few years has interfered with their use. These carbons advanced from $6.00 per carat to $18 in a few months time, but have recently dropped back to $12.

A new candidate for favor among quarrymen has been tried at Sutherland Falls and elsewhere, and this is the Saunders Channeling machine, manufactured by the Ingersoll Rock Drill company of New York city. The five cutters in a gang, forming the drill, are somewhat differently arranged from those of the Wardwell machine. The stroke of the drill is operated from the engine direct. The blows average 200 a minute; the feed averages over one inch per stroke. Among the advantages claimed for this machine are efficiency, adaptability, especially in cutting the channel at any desired angle, compactness, permitting it to be used in small tunnels and openings, and great rapidity of operation, cutting from 80 to 100 feet of channel per day.

New machines and new devices are presenting themselves to the consideration of quarrymen and whatever promises to be of real value is tested, and, bearing the test, is adopted.

The massive beds of marble here at Sutherland Falls give opportunity of taking out large blocks for building purposes. When a more valuable stone than that obtained from the quarries of coarsely crystallized marble, one of fine grain and firm texture, is demanded for architecture, the marble at this place will meet the requisition.

The spire of Grace church, New York, is being built from Sutherland Falls marble, every stone of which is fitted for its destined place before it leaves the yards.

The stone may go to market in the block from the quarry, or as sawn stock from the mills, or as completely wrought work from the finishing shops.

The addition of ten gangs of saws to the sixty-three already in operation, with the opportunity for further extension, gives promise of great work in the future.

A picturesque village is growing up around the Falls, and the families of different nationalities—English, Scotch, Welsh, Irish, Canadi-

an and Italian, are blending into an industious and intelligent community.

Pittsford has the honor of having one of the earliest quarries in Vermont, perhaps the very earliest. Jeremiah Sheldon worked marble here in 1795, taking his material from the quarry now known as the Owen quarry. For many years marble for fire-places for the country around was obtained from Pittsford. The purely calcareous marbles would do excellently for the mantle and sides, but when used for the back and jambs of the old-time fire-place would fail. A variety of stone from this place, probably magnesian in character, was early sought for and widely used.

There are three beds or veins of marble running through the town north and south. The most easterly of these has a breadth of about 200 feet and on it was opened in 1871 the quarry known as the Central Vermont quarry. It was successful until the great depression of 1874, from which it has not as yet rallied. The marble is of the same character as that of Proctor, or Sutherland Falls, of which bed it is probably a continuation. The middle bed is separated from this easterly one by about 200 feet of lime rock. This bed is of itself 400 feet wide and contains marble of different shades varying from a pure white to a dark blue. The marble is of excellent quality and very sound. Buildings made of this marble have stood the test of years without showing signs of weathering. An illustration of the enduring character of the marble from this bed is seen in the house known as the Conant house in Brandon. The Pittsford Quarry company formerly, operating on this, furnished marble for several large buildings in Boston, among which may be mentioned the Continental Building, Commonwealth Hotel and the Blackstone National Bank building.

On the same central bed with the Pittsford quarry, which has been wrought so many years and to the north of it, is the valuable property of the Wheaton quarry, now known as the Florence and Wakefield. About three-fourths of a mile south of the Pittsford quarry in 1880 Mr. F. W. Smith of Burlington opened two quarries, one on the east-

ern border and one on the western of the same bed. These quarries are known by the name Florence and the station at the railroad has come to bear the same name. The Florence quarries are about two and a half miles north-west from the Pittsford station and about three-fourths of a mile west of the railroad. The supply of Florence marble seems inexhaustable and from its superior quality is fast coming into favor. The third or west bed, thought to correspond to that of West Rutland, is about half a mile west of the central and abuts on the west against the slate, the slate having disappeared from all the region east of it. This bed, about 400 feet wide, holds beautiful dark-blue marble veined and mottled. Such marble has only recently been demanded in trade. Within a year these quarries have been opened to supply the new call for dark marbles. That opened by F. W. Smith & Company is known as the Florentine quarry and has been a great success almost from the moment of opening.

During the year seven quarries were operated. Considering the extent of the deposits and the character of the marble, no one can mark the bounds of the prosperity of the marble industry in the town of Pittsford. The output of merchantable marble during the year 1884 was nearly 10,000 tons.

Brandon has many varieties of rocks on the marble range, and early after the settlement of the town men were engaged in the production of marble. As many as ten quarries have been opened within the limits of the town, though few of these have produced desirable stone. Of those which have been wrought with considerable activity, beginning with the oldest, is the Goodell quarry about two miles south-west of the village, closed about five years ago; the Prime quarry two miles south of the village, not worked; the Billings quarry, between those mentioned, active from about 1874 to 1879. The quarry recently opened (1882), known first as the Redpath quarry, now called the Bardillo, nearer the village, is the one in most active operation, employing perhaps fifteen men at the quarry and ten at the mill. This quarry is most admirably situated for excavation; the blocks are cut out from the hill-side, placed on trucks and transported easily to the

mill which is but a few rods away. The stone is rather dark for monumental purposes and the company owning the quarry being large building contractors, use much of the stock for their own work. The other quarries opened, either from the injudicious method of excavating, or from the character of the stone, have not been remunerative and are for the present abandoned.

The history of the marble industry in Middlebury reaches back almost to the very beginning of the century. According to Prof. Fredrick Hall, marble was discovered here in 1802 by Dr. Ebenezer W. Judd and first sawed by him here in 1805. The sawing that year was preliminary to a larger business, which was entered upon in 1808 and continued at the same place until 1837. During these years the marble was quarried on the west bank of the Otter just below the falls. It was sawed by water-power close by the place where it was obtained. It found a market in New York, Boston and other cities. The amount of sawn marble produced annually in those early days of the business was from 5,000 to 10,000 feet, the standard of thickness being two inches. In 1815, which year may be taken as a fair average year, the sales amounted to $7,000, the expenses about $3,000. Some of the blocks sawed were taken from the bed of the river just above the falls at times of low water.

Other quarries, mostly in the northern and eastern parts of the town, have been opened. One of the oldest with its mill was early known as the Spaulding or the Phelps quarry. It has since been known by various names, as the North Middlebury, Old Middlebury, and Cutter Quarry. By this last name it is now known and is the only quarry in operation in the bounds of Middlebury. Other quarries have been designated as the White or Foot Street quarry, the Vermont, and the Addison County. In all these, expensive excavations have been made, but they have failed to be remunerative. In most cases beautiful white marble has been obtained, but the amount free from flaws and wholly sound has been so small that the proprietors have not felt encouraged to continue the work.

It is a matter of prime importance that the cause of this unsound-

ness should be determined. If the beds were shattered throughout the whole structure at the change from limestone to marble, no hope can be entertained of successful work on these strata. If, however, the flaws are only superficial and caused by external agency, then deeper excavation will afford sound marble. If the latter is the case, it may be assumed with entire confidence that untold wealth is buried here, waiting for those already combined, or whom it may invite, to come and uncover it. The opening of large beds of sound rock similar in character to that already obtained and scarcely tested will give Middlebury the reputation of producing the toughest, whitest, best statuary marble of the whole range.

The asserting that the character of the marble of this range deterrioates in grain in going south from Rutland and in soundness in going north, is not well established. It is true that going north some of the layers do become finer in texture, but until the layers deep in the earth have been examined it will be too early to say that throughout the region they are unsound. In grain and texture the white marble of Middlebury is known to be the perfection of beauty. In the deep layers it may be proved to be the perfection of soundness.

Brief mention should be made of rock deposits that at some time have been used as marble. Those bordering Lake Champlain have undergone but little change and so retain more nearly their original character of limestone.

At Larrabee's Point in Shoreham, Addison County, are deposits of black marble rivaling the Irish of Kilkenny in character. Fossil shells appear in some parts, giving a variegated appearance to the stone. At one time a quarry here was wrought with great success. Elaborate and beautifully-polished chimney pieces wrought from this black marble are to be found in some of our older houses. The quarry is awaiting a return of public demand for the dark marbles, when it will yield, as formerly, an excellent material for mantel and ornamental work.

Isle La Motte in Lake Champlain has at one point on its eastern shore a rock deposit like that of Larrabee's Point, and like that has

been worked and for the present is abandoned. But to the south and west and near the west shore of the Island, a quarry, lower down in its geological horizon, has these many years been worked with great success. The massive dark stone is considerably used for moumental purposes, but is largely demanded as tiles to be laid in floors in connection with the white marble. Fossil shells of great beauty are not unfrequently found even in the tiles sent to market.

Swanton, in Franklin county, formerly furnished a dove-colored marble which was extensively used for gravestones. From 1812 on for many years marble was sawn at this point, but near 1844 Rutland marble displaced that furnished by Swanton and after 1850 the quarrying of this beautiful stone was wholly abandoned.

The line of the State of Vermont does not limit the range of marble rock; but it continues into the Dominion of Canada, where just north of the line the black marble has been extensively quarried.

A peculiar rock, scattered as boulders above the marble of Addison County, is found in place not far from the shore of Lake Champlain in Addison, Chittenden and Franklin counties in Vermont. This rock as to its geological position is below the true marbles belonging to the Potsdam; but in several localities it has by a series of uplifts been thrust up through the true marble-forming rocks. The rocks of these up-thrusts, often called the red sand rock, are coarse in texture where they appear in Addison county, but in the counties north, especially at Mallet's Bay in Chittenden County and near St. Albans, Franklin County, they became so like marble in character that they are worked as true marbles, and the product is known in commerce as Winooski marble.

It would be next to impossible to overpraise the beauty of this stone. In color it varies from a dark mahogany to a white but slightly tinged with red. At its best it is charmingly mottled, constantly varying, having more frequently a ground work of light chocolate with which are blended lighter tints and then again mixed with pure white spots and veins. The whole seems like a commingling of

agate, jasper, opal, carnelian, and at times serpentine added to pure white marble. As a fancy marble it cannot be surpassed.

In composition it is a magnesian limestone containing a notable per cent. of silica, iron and alumina. Its texture is very fine and it takes a remarkable polish. One peculiarity of the stone has prevented it assuming its proper place as a commercial marble, and this is its hardness. Owing to this quality, the sawing and polishing is costly and therefore it has not come largely into use, beautiful as it is. It is waiting for improved methods of working to be devised, and when this is done the Winooski marble will be in great demand. Like the black marble of Isle La Motte, it has been for a long time manufactured into floor tiling, for which it is admirably adopted. Its beauty and value become more striking, however, when polished and worked up into interior decorations, as may be not unfrequently seen in some of the public buildings in the cities and noticeably in the capitol at Albany.

Returns from the census will probably give accurate statements of the amount and value of the marble used in our country as well as the sources of supply.

On the authority of Robert W. Welch, late consul at Carrara, Italy, (Century, June, 1882), we have the information that there is obtained from the four hundred quarries at that place, worked by about five thousand men, an annual product not far from 150,000 tons of marble, this amount saved from the 500,000 tons blasted out of the quarries; of the amount, about 25,000 tons, or one-sixth, comes to the United States.

Our government returns, according to good authority, however, show a considerable increase over this estimated amount, the quantity reaching 35,000 to 40,000 annually, or about 400,000 cubic feet of veined marble. This pays about 75 cents duty, making the rough blocks worth about $2.50 per cubic foot, or altogether a sum of $1,000,000.

At a session of the Tariff Commission held in the city of New York, October, 1882, Gov. Redfield Proctor in his testimony estimates the

capital invested in the production of American marble in the States of Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Maryland and Tennessee to be at least $12,000,000, two-thirds of this in quarries, one-third in mills and other improvements.

The number of workmen engaged is 6,000, one-half of whom may be considered skilled workmen, engaged in operating and managing machinery.

The amount of annual production is about 2,200,000 cubic feet, or over 20,000 carloads; and the value, $4,500,000. This is five times the number of cubic feet and three times the total value delivered in our port, duty paid, of all marble imported per year.

Of this about half is used for building; the other half being used mostly for marble mantels, furniture marble, monuments and cemetery work. This half competes with the imported Italian. Our country now demands for the purposes just named, of the Italian 4,00,000 cubic feet, of the American 1,100,000 cubic feet.

The Italian marble does not endure outdoor exposure as well as the better class of American, so that for this first there is no increase of demand for cemetery purposes, while for the same purposes the American marble is rapidly gaining in reputation and use.

Gov. Proctor's estimate of the annual product of the quarries of Vermont is 1,200,000 cubic feet, with an increase of about 75,000 feet per year. At $2 per cubic foot, $2,400,000 may be regarded as a fair estimate of the sum annually realized from the marble quarries of Vermont.

APPENDIX.

DEVELOPMENT OF MACHINERY.

THE following statements, without being complete, will show the use and improvement of machinery for quarrying and working marble, with authorities and dates:

1. The mallet, chisel and drill were used in stone-work from the earliest times, the two latter in Egypt, of bronze.

2. Hand-saws without teeth, fed by hand with sand and water, were used 350 years before Christ. Pliny: Translated by Philemon Holland. London, 1601. Folio. Tom. ii., 571.

[The earliest recognition of marble work by Pliny is that of the palace of Mausolus at Halicarnassus, as encrusted or veneered throughout with marble; the kinds of sand, coarse or fine, being described with which it was sawed.]

3. Saw mills for sawing stone, driven by water-power, were in use on the little river Roer in Germany, in the fourth century of the Christian era. Beckmann, referring to the Mosella of Ausonius, Vol. ii., 370. Prof. John Beckmann's History of Inventions, translated from the German by William Johnston; two volumes; London, 1797.

4. Long, toothless saws, as long as twenty-three feet, were used by Misson, Inspector of the Pyrenees quarries, for sawing out blocks of marble, before A. D. 1700. M. Felibien (ob. 1687), quoted by Chambers' Cyclopedia, 2d edition, London, 1738.

5. Two or more saws stretched in a frame, forming a gang, were figured by Leonardo da Vinci (ob. 1519). Clarence Cook in "Scribner's Monthly," Vol. xvii., p. 337.

[Saw mills for wood-sawing, as stated by Beckmann, were in use at Augsburgh in Germany as early as 1322, and occur often in many other countries in the following century. In Norway first in 1530. In the same century there were saw mills operating several blades to cut several deals at once from the same plank.]

6. Saws carried by water-power, reinvented by William Colles, Kilkenny, Ireland, 1730.

7. Polishing and boring done at the same place as above, and by the same power.

8. Sawing and polishing by water-power established at Ashford, Derbyshire, Eng., 1748.

9. Automatic feeder, distributing sand and water, Philo Tomlinson, Marblehead, Conn., 1800.

10. Arrangement for raising and lowering saws, E. W. Judd, Middlebury, Vt., 1822.

11. Planing mill, Charles B. Boynton, West Stockbridge, Mass., 1836.
12. Use of steam for sawing blocks in quarry, as above.
13. Channeling machine, George E. Wardwell, Rutland, Vt., 1863.
14. Diamond drill, used in England and France near 1850.
15. Diamond gadders, Sullivan Machine Co., Claremont, N. H.
16. Diamond saw,used at East Canaan, Conn., 1876.
17. Rock drill, W. L. Saunders, New York, 1883.
18. Various elevator arrangements for feeding sand and water continuously, 1883, 1884.

CORRESPONDENCE.

MANY of the facts recorded on the preceding pages have been received through the courtesy of friends, whose letters have been freely used and the statements condensed. It is next to impossible to give proper credit to the many to whom expressions of obligation are due. These gentlemen will please regard the acknowledgement here made as designed for them individually, and also accept a copy of the present publication of the Middlebury Historical Society as indicating an appreciation of their kindness.

In a few instances the letters received have such a direct bearing upon the progress of discovery treated of that they could not be condensed, and are here given nearly entire. It is hoped that these friends will pardon the liberty taken in publishing their letters without their authority.

[From Richard Colles, Esq., Kilkenny, Ireland.]

KILKENNY MARBLE MILLS,
3d March, 1884.

To Henry M. Seely, Esq., Middlebury, Vt., U. S. A.

Dear Sir—My sister has handed me your letter of inquiry relative to the sawing of marble by water power.

I cannot fix the exact date of the invention of the marble sawing mill by my ancestor, William Colles, but it was probably about 1730 or shortly afterwards.

In Tighe's "Survey of the County Kilkenny," published in 1802, it is stated that "he first tried a model in a small stream, and finding it succeed, took a perpetual lease of the marble quarry." His lease of the quarry dates from 1737, so this statement very nearly settles the date of the invention. The same book quotes from "A Tour in Ireland" by two Englishmen, published in London in 1748: "I cannot hear that any one has attempted to imitate the machinery. It is perpetually at work, by night as well as by day, and requires little attendance. . . . Though the stones in the quarry sometimes might weigh several tons, yet the method the contriver has used to lift them, draw them out, and convey them to the mill, without any other than manual operation, adds still more to the surprise. I am informed that this ingenious gentleman sends yearly

several ship loads to England, which gives me a particular satisfaction, that they may find a native of Ireland has outdone all they have hitherto seen."

The foregoing I think gives you the information you require, but should you wish to make any further inquiry, I shall be very happy to reply to it.

Yours, faithfully, RICH. COLLES.

KILKENNY,
10th April, 1884.

Dear Sir—I was pleased at receiving your letter of 19th March, and in reply to your inquiries beg to say that the saws used here were originally, as they are still, of soft hoop iron, and fed by sand and water. They were all single blades, not working in a gang.

I am not aware where several saws were first used together in a frame, but it was not here. There seems to have been rather a pride taken in keeping to the original form of saw frames, and it was not until my father's time that the present frames, with a large number of saws working together, were erected.

Many thanks for your kind promise to send me a copy of the pamphlet on the subject, if published.

I fear, as you say, this is the wrong time of year for obtaining roots of Cypripedium, and trust you will not go to too much trouble about them, though certainly if easily obtained I should much like to have so pleasing a memento of our correspondence.

I am, dear sir,

Yours very truly, RICH. COLLES.

HENRY M. SEELY, Esq.

[From Rev. James Graves, B. A., Inisnay Rectory, Strongford, Co. Kilkenny, Ireland.]

INISNAY GLEBE, STRONGFORD,
March 17, 1884.

Dear Sir—I have much pleasure in sending you herewith extracts from two published works which fully prove that the driving of soft iron toothless saws for cutting stone by machinery moved by water power was invented by Alderman W. Colles of Kilkenny and at work before 1768.

The black marble of Kilkenny has been worked for centuries, and I have no doubt that the soft iron saw worked by hand was used at a date long before Colles invented the application of water power to saws, polishers and borers. The marble of the Black Quarry is still worked, and the same mills and machinery employed by Alexander Colles, fifth in descent from Alderman William Colles, who invented and applied that machinery more than 160 years ago.

I thank you for the paper which you sent, and am

Yours, very faithfully, J. GRAVES.

Statistical Observations relative to the County of Kilkenny made in the year 1800 and 1801. By Mr. Tighe, Dublin, 1802.

Page 103, etc., after describing the Black Quarry and the marble produced by it, the work goes on to state:

"But the principal work is done at the marble mill which is on the left bank of the river [Nore] nearly two miles from Kilkenny. . . . This mill is admirable for the simplicity of its structure, . . . the wheel, 12 feet in diameter, with 12 floats, gives motion by a crank at one end of its axis to a frame containing 12 saws . . . by a crank at the other end it moves a frame of 5 polishers. . . . The saws are made of soft iron and last about a week. They are continually supplied with water and sand. . . . The machinery of the mill was the invention of Alderman Colles, grandfather of the present proprietor, Mr. William Colles. He first tried a model on a small stream. . . . In the time of Alderman Colles the mill bored as well as polished, and he applied his marble to a vast variety of articles—as marble tubes, which he undertook to supply to the corporation of Dublin as pipes for distributing the water through the city."

In a "Tour in Ireland," published in London in 1748, by Two English Gentlemen, Alderman Colles' mill is described as above and it is said, "I cannot hear that any one has attempted to imitate the machinery. It is perpetually at work, by night as well as by day, and requires little attendance."

[From Mr. James Clapp, M. A., Master of the Merchant-Tailors' School, London.]

32 MYDDLETON Sq., LONDON, E. C.
May 3, 1884.

My Dear —— Having a holiday, I have been down to the British Museum again to see if I could settle the date of the introduction of the saw-mill for marble into Derbyshire a little more definitely. You will be pleased to hear that I have been successful. . . . .

* * * * * * *

I happened to light upon "Tomlinson on the Useful Arts," and found what I wanted at once—quite by accident—most literally so, for the book fell open at the spot. . . . Tomlinson says: 'The principal manufacture of England is in Derbyshire, along the valley of the Derwent and the Nye, from below Buxton to Derby. The machinery for sawing and polishing was first established at the village of Ashford, near Bakewell, in 1748, water being the motive power. About 1810, similar machinery was erected at Bakewell. Both these works are situated near the quarries." He says the machinery for polishing is similar to that for sawing.

The only thing Tomlinson could have added to complete my satisfaction would have been his authority which I could have looked out for verification sake. He gives

good diagrams of sawing mills—gangs of parallel saws similar to those I have seen at the slate quarries in Cornwall. It is a most interesting spectacle—the sawing, preparing, polishing of stone. . . . The complete account given by Tomlinson is verv interesting, and enables one to quite understand the history and process of sawing marble. . . .

Now, feeling sure that you will be glad I have at last found something definite and exactly to the point, I remain

Always yours, JAS. CLAPP.

[From Ralph Buckingham, Esq., Marbledale Conn.]

MARBLEDALE, Feb. 27, 1884.

Mr. Philip Battell,

Dear Sir—Yours of Feb. 23 received. In reply to your inquiry about the marble business in New Preston, which formerly included Marbledale, I have no documentary evidence of the beginning of the business here, but there are two very old, intelligent men who have successfully engaged in the business from their early years, from whom I have obtained my information of the coming of Philo Tomlinson, and the date of his entering into business. William Morse, born in 1800, nephew of Philo Tomlinson, came to New Preston in 1817, in the employ of the Tomlinsons' and is now, notwithstanding his age, probably the most of an expert in his knowledge of the quality of marble and its artistic manufacture of any ever in business here. He gives me the history of the Tomlinson family, their removal from Derby in New Haven County where they first quarried, when the first mill was erected, and the process of sawing, etc.

He says he knows the first quarry was opened for blocks for sawing in 1800, and the mill was erected at that time, with substantially the same manner of sawing with a water wheel with a crank in each end moving a horizontal frame with several strips of iron, set the distance apart in the frame required to determine the thickness of the slabs, so called, and a box over the block with an apparatus for conducting sand and water to the saws, and nothing has ever been known here of any other process of sawing marble.

The Rev. George Tomlinson, grandson of Philo Tomlinson, said to me that the Rev. Horace Bushnell (of national reputation) told him of visiting the mill of his grandfather, and his "admiration of the simplicity and perfect adaptation of the invention of his grandfather for conducting the sand and water to the saws."

Medad J. Goodsell, now living in full possession of his faculties, who entered into the business in 1820, and who has carried on the business more extensively and successfully than any other who ever engaged in it here, tells me that he went to Mr. Philo Tomlinson's mill when he came here in 1820. Mr. Tomlinson told him he had been sawing marble there for twenty years, which would make the date 1800, and Mr. Goodsell says he said nothing of any other process of sawing than what was then used. The

oldest marble tombstone in the graveyard here was erected to my wife's great grandfather, one of the first settlers of New Preston, Joseph Wheaton, in 1789. This was hewed stone with polished face. Sawed tombstones of marble were not erected before 1800. After that date sawed marble was almost universally used.

I can find nothing which would indicate any conclusion but that marble was sawed substantially as at present, with a gang of strips of iron, set in a horizontal frame fed with water from a perforated tube, and a box filled with sand furnished with conductors, which box received a jar from a stick attached to the machinery in order to keep the con ductors filled—by Philo Tomlinson of Derby, in New Preston in A. D. 1800.

The first mills erected had one wheel carrying two gangs of saws. Afterwards most of the mills had two wheels carrying four gangs.

It gives me great pleasure to reply to your inquiries and any one who is engaged in searching out and rescuing any branch of the history of our country deserves the help of all good citizens.

Believe me,

Very truly yours, RALPH BUCKINGHAM.

[From Chas. J. Taylor, Esq., Great Barrington, Mass.]

GREAT BARRINGTON, MASS., Feb. 25, 1884.

Philip Battell, Esq., Middlebury, Vt.

My Dear Sir—In replying to your letters of 15th and 19th inst., I may perhaps, write more than is immaterial than pertinent to the line of your investigation. In regard to the appliances used in sawing and quarrying of marble in early days, it seems to me in the absence of records or account books we must rely almost solely upon the individual recollections of men who have been familiar with, or engaged in the business. The personal knowledge of not very few of these extend back to the beginning of the century. I am the more forcibly reminded of this by the very recent death of Chester Goodale of Egremont, at the age of 93, whose boyhood was spent in West Stockbridge, and who was for many years engaged in quarrying and sawing marble in Sheffield. The next in order of age, of my acquaintance, is Major Robbins, 86 years old, mentioned in my last letter; he was long engaged in the marble business in West Stockbridge. I have had a recent interview with him, of which more beyond.

I have always found old account books a fruitful source of information as to local matters, and though I have many of these none pertain to the marble interests.

I wrote you that Newell and Cook had, as early as 1802, erected a stone saw mill, a water mill, at the "Old Quarry" below West Stockbridge Village, and that I found reason for believing that they had a still earlier stone saw mill on the same stream, in West Stockbridge Village.

In this belief I am still further confirmed. Newell and Cook certainly did have such

a mill at the village in 1803; they apparently had it in 1802. It appears to have stood upon a half acre, adjoining the river, which was purchased by Newell in 1794. (Newell and Cook are designated as "stone cutters" in a deed of 1799), and although I cannot, as yet, trace the existence of this mill back of 1802, I am prepared to believe that it was erected earlier, and, probably, before the year 1800. So far as my examination reaches, Newell & Cook appear to have been the pioneers of marble sawing in West Stockbridge.

Major Robbins says his first visit to the Newell & Cook mill, by the "Old Quarry," was in 1806 or 7; that they had two gangs of saws and "a slipper" (whatever that may be), and that they ran the mill night and day; that the saws used were thin plates of soft iron with sand and water; that his father then explained to him their working; that the stone was suspended in a frame within a larger outer frame. He has no knowledge of any earlier appliances for cutting, than these toothless saws.

He says the marble in the "Old Quarry" was in layers, inclined, one upon another, and was broken out drilling and wedging. Major Robbins was, later, engaged in the business himself. He mentions a machine used, perhaps, by the Boyntons, (later than Newell & Cook's) for planing marble in which chisels were worked back and forth, producing a surface better than was done by saws and sand. He also says that at one of the mills, the sand and water running from the stone was caught in a receptacle below, returned to the saws and was thus used over and over. Mr. Robbins states that the Boyntons, about 1828 or '30, built a mill for running by steam; but this proved exsive, costing, as the sawyer asserted, 28 cents per foot for sawing, whereas it was done at 5 cents per foot at a water mill.

He also describes a process employed by the Boyntons for breaking out the stone from the quarry; this consisted in cutting a trench with picks at each end of the block to be removed, and also on its under side; drills and long wedges were then used in the lower trench, and with the aid of a light charge of powder the whole was loosened. He further says that the Boyntons made use of saws driven by steam for cutting out the blocks from the quarry. The marble business has been a very important business in West Stockbridge, though little or nothing is now done at it. Maj. Robbins says "they can't compete with Vermont marble;" still Lee is largely engaged in this business, and large quantities are shipped from that town.

In 1803, Feb. 15, Nathan Johnson and Elisha Stevens, Jr., "stone cutters of West Stockbridge," purchased a tract of twenty-eight acres in West Stockbridge; this, as I understand, comprised the quarry now known as the "Fitch quarry," which, by change of town lines, is now in Alford. From that quarry Johnson & Stevens furnished large quantities of stone for the New York City Hall—some stone for the same building are said to have been taken from the "old quarry."

I have not learned at what date Johnson & Stevens began quarrying for the City Hall, but Martin Reese writes me that they were sawing stone on that contract at the "old quarry" in 1809.

As yet I know nothing of the Johnson & Stevens methods in quarrying, but I may get it, second hand, from elderly men still living in that vicinity.

Relative to the Sheffield marble, I have yet no more information. The early operations there are not so distinct as those at West Stockbridge, and I believe the West Stockbridge works *are the earlier*.

Sheffield has several quarries. I am not aware that any of them are now worked. The first of these (so far as I know) are the "Goodale quarry" (I have mentioned Chester Goodale, he could have told us all about it), and what I will term the "Upson quarry." From the latter the stone for Girard College were taken about 1838 to 1841. I think this quarry had been previously worked, but have not studied it up. Philo Upson of Egremont was the operator; he was lost by the burning of the steamer Lexington in the Sound about 1841.

Upson (I think in connection with Philadelphia parties—the firm, I believe, was Jacobs, Conony & Upson) had the contract for furnishing stone for the College.

Mr. Goodale had a quarry about a mile north of Upson's, and also a saw mill three-fourths mile from his quarry.

Other quarries in Sheffield have, within a few years, furnished marble for the Court House at Pittsfield and in part for the Capitol at Albany. I have never before heard of the West Stockbridge chronicler—Spencer(?). The name still remains there, and I will make inquiries.

I hope to learn something more of the West Stockbridge manner of sawing, but do not expect to get back of water with iron saws and sand; and I will endeavor to find out about Johnson & Stevens' methods of quarrying.

I do not remember to have seen what Dr. Holland says of the Berkshire marbles. In Dr. Hitchcock's Report—1832—I see he gives the number of saw mills in several towns of this county (though he does not mention the one then in use in this town), and also a statement of the value of marble produced in some of the towns. . . . .

I am, very truly yours, CHAS. J. TAYLOR.

[The general statement of veins of marble within the New York boundary is made in the History of Duchess County, by Philip H. Smith, published in 1877, p. 29, as follows:]

"Within the New York line beds of marble, similar to those found in Massachusetts near the borders of this State, exist in the towns of Amenia, Dover, Pawling, Beekman and Fishkill. In Dover, the quarries have been extensively wrought; and the marble which they yield, although dolomite, is pure white, fine-grained, and takes a medium polish. Clouded marble occurs in the towns of Amenia and Northeast."

[From John Struthers, Esq., Philadelphia, Pa.]

WALNUT ST. WHARF, SCHUYLKILL,
Philadelphia, Oct. 4, 1884.

My Dear Stone— . . . . The first white marble used in this city, as far as I can trace upon records, was the East Dorset, Vermont, and West Stockbridge, Massachusetts, followed by Manchester and Rutland, Vermont; later on the variegated from Lake Champlain and through sections of Vermont, to a considerable extent. The Lee marble from Massachusetts, Berkshire County, has furnished all the marble in our new City Hall, our largest marble building; in the work, 702,000 cubic feet or 60,000 tons. Blocks weighing thirty tons have been quarried and twenty-four tons set in one block in the building.

The Capitol at Washington is built of this marble, considered the strongest in the world.

Marble from the quarries in Vermont owned by Mr. John K. Freedly, is famous for its usefulness in buildings and for monumental stock, being white and remarkably sound. Most of the stores of white marble in this city are built of it; the Drexel building in New York also.

I presume of the Vermont marbles upwards of 30,000 cubic feet have been used in the past three years.

Sincerely yours, JOHN STRUTHERS.

F. D. STONE, ESQ.

EARLY WORK

IN

MARBLE AT MIDDLEBURY.

JUDGE SAMUEL SWIFT, in his History of the Town of Middlebury, published in 1859, quotes from the pamphlet of Professor Frederic Hall, who published in 1821 a Statistical Account of Middlebury, as follows:

"Proceeding down the creek, on the western side, after passing two saw mills, two grist mills, a clothier's works and some other establishments of minor importance, you come to the Marble Factory. The marble in this village, which is now wrought on a large scale, and extensively diffused over the country, was discovered by Eben W. Judd, the present principal proprietor, as early as 1802. A building on a limited plan was erected, and machinery for sawing the marble (the idea of which had its origin in the inventive mind of the proprietor) was then first put in operation. In 1806 a new and commodious building, two stories high, and destined to comprise sixty saws, to be moved by water, was erected. In 1808 this enlarged establishment went into operation, and has continued to the present day."

"The saws are made of soft iron, without teeth, and are similar in form to those which are used in sawing marble by hand in the large cities in Europe. The softer they are the longer they last." "The marble until lately has been obtained chiefly from a quarry, situated within a few feet of the mill. During three or four of the last years, much has been procured, at the time of low water, at the bottom of the creek, immediately above the falls. It is raised from its bed, partly by means of wedges, but principally by blasting." "The marble, after being sawed into slabs, is manufactured into tomb stones, currier's tables, jambs, mantle pieces, hearths, window and door caps and sills, side boards, tables, sinks and various other kinds of furniture. These articles are transported to Montreal, Quebec, Boston, New York and even Georgia. The machinery has sawn annually from five to ten thousand feet since the year 1808."

This was the first manufacture of marble upon an extensive scale established in this State, and the machinery for sawing on this plan was first put in operation by Dr. Judd, and has since been extensively adopted elsewhere. He was an ingenious and somewhat scientific man, of experience in business life. In anticipation of establishing the manufacture of marble, in the spring of 1803 he obtained from Appleton Foot a lease for 999 years of the right to dig marble on any part of his lot, between his house and the creek, the foundation of which was marble throughout, and the privilege of erecting

a mill. He afterwards obtained a title to the land in fee, and occupied the house on it, until he built, on the same site, the large brick house, now owned by Dr. Nathaniel Harris.

Rev. Dr. Dwight of Yale College, on his visit in 1810, says of this marble and its manufacture: "A quarry of marble has been discovered in the bank of the river just below the bridge, a continuation of the ledge, which forms the falls. It is both white and dove-colored, elegantly variegated, and of finer texture than any other which has been wrought hitherto in the United States. It is sawn, ground and polished by water machinery; and is cut and carved, with an elegance not surpassed on this side of the Atlantic."

Judge Swift further says: "After Professor Hall's account above quoted, Dr. Judd purchased the quarry of beautiful black marble, on the lake shore in Shoreham, which he transported by teams and extensively manufactured at his mill here. In the year 1820 he received into partnership his son-in-law, Lebbeus Harris, son of Lebbeus Harris, Senior. By them the business was largely prosecuted, and agencies for the sale established in some of the large cities, and in Western New York. In 1837 the whole establishment was brought to a close by the death of both the partners. Mr. Harris died in April, at the age of forty-five, and Dr. Judd in September, at the age of seventy-six. The mill has never been in operation since. Dr. Nathaniel Harris, a brother of Lebbeus, who had also been engaged in the business in various ways, continued the manufacture on a small scale for a few years. Mr. Daniel Judd, son of Dr. Judd, still prosecutes the business on a small scale in a shop near the former factory."

LOCAL QUESTION OF INVENTION.

Several valuable inventions have been claimed for the town of Middlebury, and at the building of the new Town Hall it was proposed by some of the citizens to honor such inventors by inscribing their names on a tablet within the edifice. Who were worthy of this honor was a matter to be decided. Among those named was a young Middlebury lad, Isaac E. Markham, for whom friends set up the claim, that early in the century, at ten years of age, he was the inventor of the present method of sawing marble; that of driving by water power toothless saws fixed in gangs and fed by sand and water.

The Middlebury Historical Society called on one of its members to investigate the validity of this claim of the friends of Markham, and at the same time to give, incidentally, a statement in regard to the sawing of marble.

The facts of the case were collected and read in a communication presented at a meeting of the society, which was approved and directed to be published.